SEP 1 1 1945

ENGINEERING NEWS-RECORD

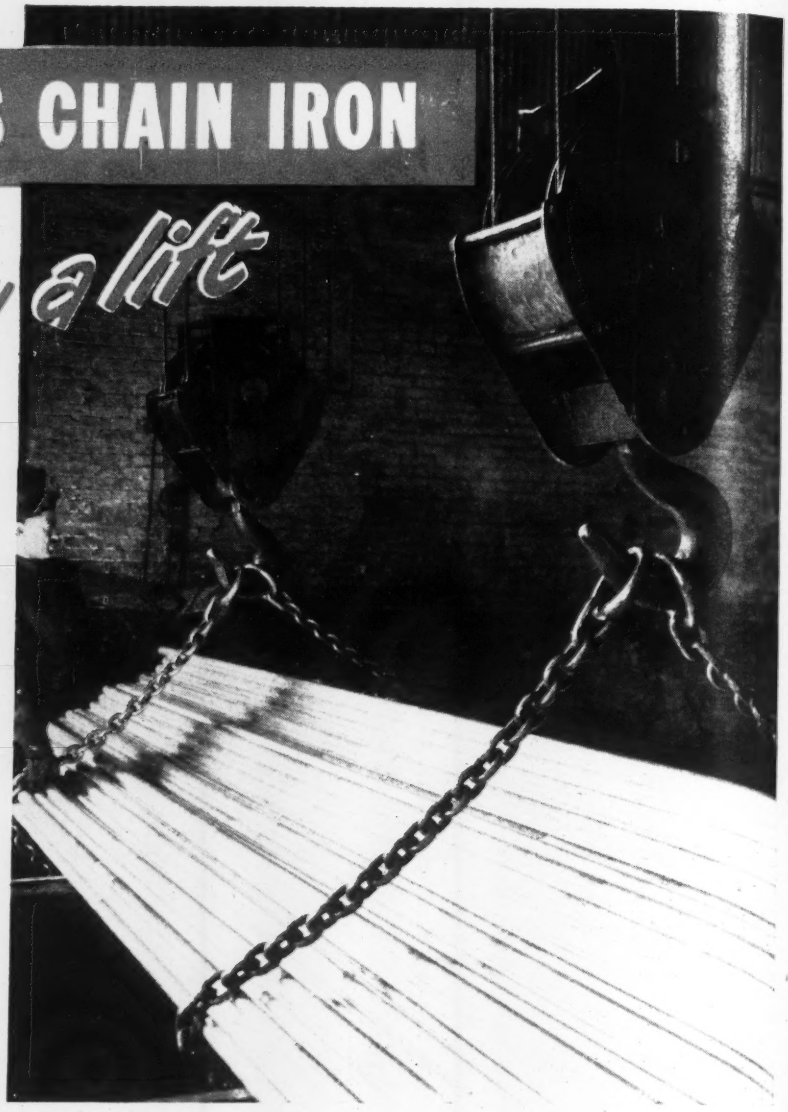
SEPTEMBER 6, 1945

Seabees excavated 1,250,000 cu. yd. of coral from this pit to build B-29 bomber bases on Tinian Island—See article inside.

In This Issue

A SPECIAL SECTION ON WATER SUPPLY

Let BYERS CHAIN IRON give you a lift



Sling chains are only a small item in heavy construction equipment, but they have an importance beyond their size, and the fact that Byers Chain Iron is now available for repair should be welcome news to every man who maintains the chains, and to the blacksmith who forges the links.

The biggest contribution that Byers Chain Iron makes is in the advance warning of failure it gives when overstressed. Links that have been loaded beyond their capacity "neck-out" so that the weakness is apparent in visual inspection, and the chain can be withdrawn for repair before failure actually occurs. The savings that this one unusual property has made in accidents avoided and equipment damage averted can hardly be overestimated.

The excellent forming and welding properties of Byers Chain Iron recommend it to the craftsmen who make the actual repairs. It is easily worked on the anvil, gives a weld that is fully equal in strength to the adjacent metal, and heating, cooling and hammering do not produce undesirable or unpredictable changes in its physical properties.

Byers Chain Iron has an additional advantage when materials must be handled into and out of process tanks containing aggressive liquids, or where the atmosphere is unusually corrosive. The Chain Iron has unusual resistance to corrosion from a variety of commonly used process materials.

The properties that make Byers Chain Iron so desirable for material handling come directly from its unique composition. Tiny fibers of glass-like silicate slag are threaded through a main body of high-purity iron. This gives a structure something like that of a stranded wire cable, highly resistive to shocks and recurrent stresses. The fibers serve also to halt and disperse corrosive attack, and help anchor the initial protective film, which shields the underlying metal.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

CORROSION COSTS YOU MORE THAN WROUGHT IRON

NOTE: BYERS CHAIN IRON in a range of sizes suitable for repair work is available for immediate delivery from A. Milne & Co. Just contact their nearest office in New York, Boston, Chicago, Pittsburgh, Philadelphia, or Washington.

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GENUINE WROUGHT IRON
TUBULAR AND HOT ROLLED PRODUCTS
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Publication Office: 99-129 North Broadway, Albany 1, N. Y. • Editorial and Executive Offices: 330 West 42nd Street, New York 18

WALDO G. BOWMAN, *Editor* ALBERT E. PAXTON, *Publisher*

Vol. 135 SEPTEMBER 6, 1945 No. 10

COMING NEXT

• Directed primarily to airport engineers, an article scheduled for the Sept. 20 issue will describe the ways and means adopted to keep runways free from snow—despite an annual fall of 108 in.—at the Presque Isle Airport, most northern field in the U. S. Ten or more one-way, right-hand plows operated in echelon formations at a speed of 15 to 25 mph.; three types of rotary snow throwers and other essential equipment, all operated by regular assigned personnel constitute the backbone of defense against heavy snow falls.

• Revolutionary in design yet extremely practical in its methods of manufacture and installation is a new type of flexible reinforced concrete mattress developed for revetment along the Mississippi River. Initial installations at Miller Bend, where mats 24 ft wide, 60 ft. long and 1½ in. thick were used, will be described in the Sept. 20 issue.

• Building a tunnel to withstand a man-made tornado literally describes the construction problem involved in erection of the world's largest airplane testing laboratory at Moffett Field, Calif. So exacting was the steel erection job, because of close tolerances required in framing the test section and setting the supports for six 40-ft. fans, that special traveling stiffleg derricks had to be designed and mounted on high towers. The project will be described in the Sept. 20 issue.

LOOKING AHEAD

• The longest construction cableways ever built were required at Norfork Dam for placing 1,500,000 cu. yd. of concrete. The essential features of design, erection, mechanical operation and control will be outlined in an early issue. A major failure of one of the cables was experienced. A description of the failure and a diagnosis of the cause will be given.

• The Maas River Tunnel at Rotterdam, Holland, now complete, has the distinction of being the largest in cross-section to be constructed by sinking prefabricated concrete sections to the riverbed and connecting the ends under water. Of special interest is the plant and precision methods used in sinking these sections so as to control the line and grade accurately. The project will be described in an early issue.

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Number of copies of this issue printed 38,142

DO YOU WANT AN INDEX?

Due to the paper shortage, no index for volume No. 134 (Jan.-July, 1945) will be issued except to subscribers who ask for it. If you want a copy of the index please send in the coupon below.

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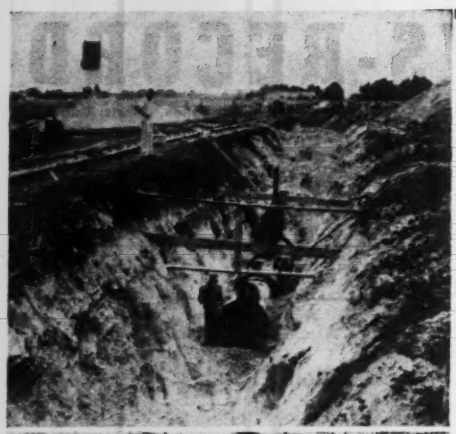

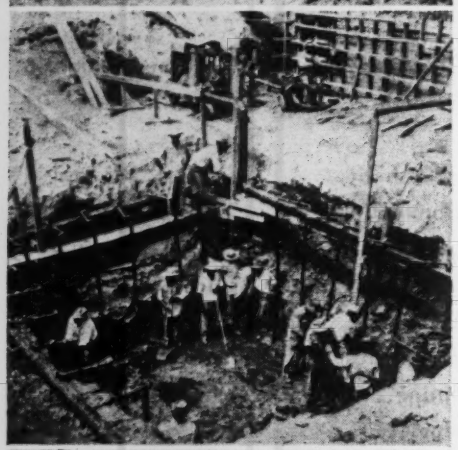

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ROCKAWAY, NEW JERSEY

New Construction in August

CIVIL ENGINEERING construction volume for the five weeks of August total $213,960,000, an average of $42,792,000 per week. This weekly average volume is 0.1 percent above the average for the four weeks of July, and is 1 percent higher than the average for the five weeks of August 1944.

Private construction, on the weekly average basis, tops last month by 82 percent and is 198 percent greater than in the month last year as a result of the increased volume of industrial and commercial buildings. Public work, on the other hand, is 27 percent below a month ago and 34 percent under a year ago. Federal construction is down 33 and 50 percent, respectively, compared with the preceding month and the corresponding 1944 month. State and municipal average volume is 13 percent below last month, but climbs 37 percent over a year ago.

The August volume brings 1945 construction to $1,261,099,000 for the eight months of the year, a total just under the $1,261,642,000 reported for the period in 1944. Private construction, $393,911,000, is 45 percent higher than in 1944, but public construction, $867,188,000, is 12 percent lower due to the 21 percent decrease in federal volume. State and municipal volume for the year to date, $218,880,000, is 30 percent above the figure for a year ago.

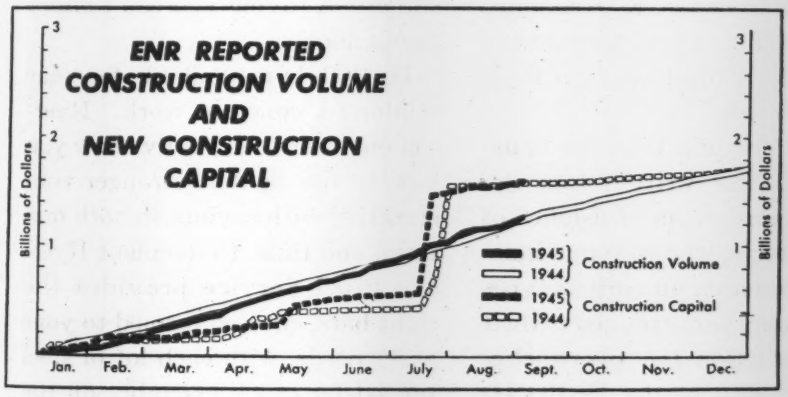
Geographically, three regions record gains over their respective July weekly averages—Middle Atlantic, 18 percent; Middle West, 19 percent; and West of the Mississippi, 25 percent. All sections of the country except Far West are above their August 1944 averages.

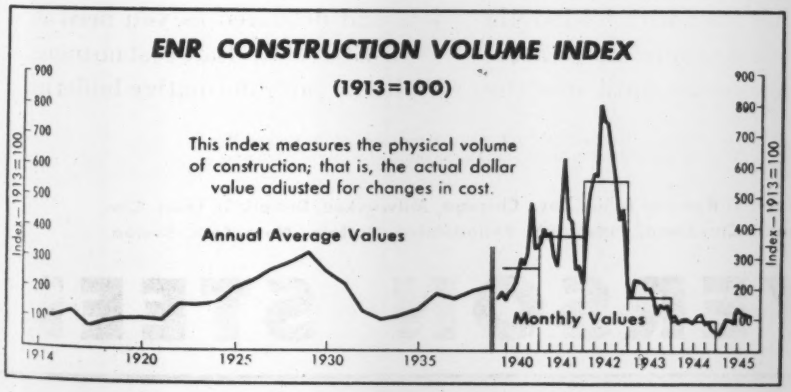
New capital

New capital for construction purposes for August totals $116,063,000, a 165 percent increase over the $43,861,000 reported for the corresponding month last year. The current month's financing is made up of $71,490,000 in private investment, and $44,573,000 in federal appropriations.

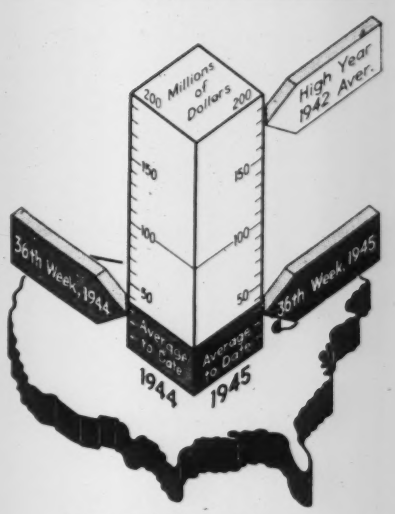
New construction financing for 1945 to date reached $1,601,763,000 for the eight-month 1945 period.

(*See Volume Table, page* 77)




ENR CONSTRUCTION VOLUME INDEX
(1913=100)
This index measures the physical volume of construction; that is, the actual dollar value adjusted for changes in cost.
Annual Average Values
Monthly Values
Index—1913=100
1914 1920 1925 1930 1935 1940 1941 1942 1943 1944 1945

CONSTRUCTION ACTIVITY



As Reported This Week to...
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only (Thousands of Dollars)

	Week of Sept. 6 1945	Cumulative 1945 (36 wk.)	Cumulative 1944 (36 wk.)
Federal	$6,115	$654,423	$840,624
State & Munic.	6,371	225,251	171,848
Total Public	$12,486	$879,674	$1,012,472
Total Private	18,275	412,186	274,530
U. S. Total	**$30,761**	**$1,291,860**	**$1,287,011**

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Type of Work	Dollar Volume (Thousands) This Week	Cumulative 1945 (36 wk.)	Cumulative 1944 (36 wk.)
Waterworks	$1,029	$36,445	$21,328
Sewerage	303	21,743	21,851
Bridges	....	22,387	10,459
Highways	2,998	150,235	148,783
Earthwork, Waterways	1,704	34,720	47,666
Buildings, Public	3,072	402,994	477,029
Industrial	9,607	273,293	124,613
Commercial	7,870	85,875	109,199
Unclassified	4,178	264,268	326,083

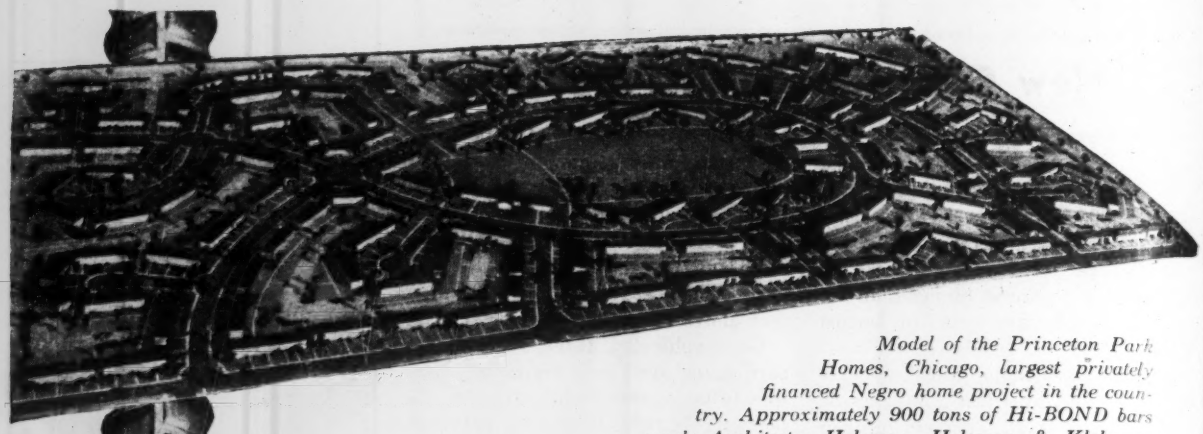
NOTE: Minimum size projects included are: Waterworks and waterway projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1945 36 wk.	Cumulative 1944 36 wk.
NON-FEDERAL	$558,784	$339,775
Corporate Securities	117,582	94,395
State and Municipal	277,602	104,590
RFC Loans	24,600	57,790
REA Loans	60,000	20,000
Fed. Aid, Highway	79,000	62,000
FEDERAL	$1,049,898	$1,263,800
Total Capital	**$1,608,682**	**$1,603,575**

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Sept. '45	309.28	148.67
Building Cost	Sept. '45	240.07	129.77
Volume	Aug. '45	119	52



Model of the Princeton Park Homes, Chicago, largest privately financed Negro home project in the country. Approximately 900 tons of Hi-BOND bars used. Architects: Holsman, Holsman & Klekamp.

Hi-BOND RE-BARS

Specified for the Princeton Project

Shipped quickly from nearby Ryerson stocks

With the wholehearted approval of the FHA engineers, Inland Hi-BOND bars were specified by Holsman, Holsman & Klekamp, Architects, for the reinforced concrete work in the Princeton Park Homes Project.

It is interesting that the name Hi-BOND was written into the Specifications at the insistence of the Architects, who, through independent research on various types of reinforcing bars,*proved to their own satisfaction the overwhelming superiority of the Hi-BOND bar. On pull tests with Hi-BOND imbedded in concrete, no measurable slippage occurs until after the yield point of the bar has been exceeded. Hi-BOND bars may be used without hooks in most instances. A saving you can't afford to overlook.

Hi-BOND is available for your reinforced concrete work. Ryerson engineers will gladly show you how to use lighter, stronger construction with savings in both material and time. Convenient Ryerson Steel-Service provides the right bars, cut and formed to your exact needs, with each lot of steel tagged for quick assembly on the job, and delivered as you need it.

Hi-BOND Re-Bars cost no more. Write for our informative bulletin.

*Tests conducted by Prof. Kurt Wendt and Prof. George W. Washa of the Department of Mechanics, University of Wisconsin.

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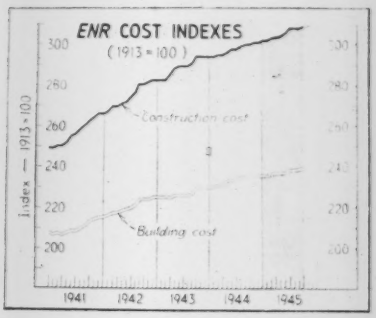
RYERSON STEEL

SEPTEMBER CONSTRUCTION BUSINESS REPORT

ENR CONSTRUCTION VOLUME AND NEW PRODUCTIVE CAPITAL

(,000 omitted)	August 1944 (5 wk.)	August 1945 (5 wk.)	% Change	Eight Months 1944 (35 wk.)	Eight Months 1945 (35 wk.)	% Change
Total U. S. Construction	$211,251	$213,960	+1.0	$1,261,642	$1,261,099	†
Private Construction	31,932	95,262	+198.0	271,706	393,911	+45.0
Public Construction	179,319	118,698	−34.0	989,936	867,188	−12.0
Federal	146,190	73,436	−50.0	821,911	648,308	−21.0
Total New Productive Capital	$43,861	$116,063	+165.0	$1,598,152	$1,601,763	+0.2
Private Investment	42,531	71,490	+68.0	193,562	388,265	+101.0
Federal (non-federal work)	1,330	.....	.....	140,790	163,600	+16.0
Federal (federal work)	.....	44,573	.....	1,263,800	1,049,898	−17.0
ENR Construction Volume Index, 1913 = 100	121	119	−2.0	104*	101*	−3.0

† *Less than .05 percent change.* * *Eight-month average.*



CONSTRUCTION COSTS . . . . WAGE RATES . . . . MATERIAL PRICES

	September 1944	September 1945	% Change	Change August to September 1944 Aug.	1944 Sept.	1944 %	1945 Aug.	1945 Sept.	1945 %
ENR Construction Cost Index, 1913 = 100‡	300.46	309.28	+2.9	300.42	300.46	†	309.08	309.28	+0.1
ENR Building Cost Index, 1913 = 100‡	236.00	240.07	+1.7	236.09	236.00	†	239.94	240.07	+0.1

‡ *Does not reflect increased costs due to overtime, lower labor efficiency, delivery delays, etc.*

ENR 20-CITIES' AVERAGE

Common Labor	$0.883	$0.917	+3.8	$0.882	$0.883	+0.1	$0.916	$0.917	+0.1
Skilled Labor (Av. 3 trades)	1.640	1.670	+1.8	1.639	1.640	+0.1	1.668	1.670	+0.1
Bricklayers	1.739	1.770	+1.8	1.739	1.739	0	1.770	1.770	0
Structural Ironworkers	1.694	1.720	+1.5	1.694	1.694	0	1.720	1.720	0
Carpenters	1.487	1.519	+2.2	1.484	1.487	+0.2	1.515	1.519	+0.3
Cement, per bbl	$2.67	$2.75	+3.0	$2.67	$2.67	0	$2.75	$2.75	0
Reinforcing steel, cwt	2.79	2.79	0	2.79	2.79	0	2.79	2.79	0
Structural steel, base	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.23	1.24	+0.8	1.23	1.23	0	1.24	1.24	0
Lumber, 2x4 Fir, per M ft.	54.58	55.63	+1.9	54.58	54.58	0	55.63	55.63	0
Lumber, 2x4 Pine, per M ft.	53.38	53.84	+0.9	53.68	53.38	−0.6	53.84	53.84	0
Common brick, per M	16.52	18.98	+14.9	16.52	16.52	0	18.78	18.98	+1.1
Ready-mixed concrete, c.y.	7.44	7.66	+3.0	7.44	7.44	0	7.66	7.66	0
Struct. clay tile, 3x12x12	80.48	85.07	+5.7	80.48	80.48	0	85.07	85.07	0
Paving asphalt, cars, ton	15.40	15.48	+0.5	15.40	15.40	0	15.48	15.48	0

† *Less than .05 percent change.*

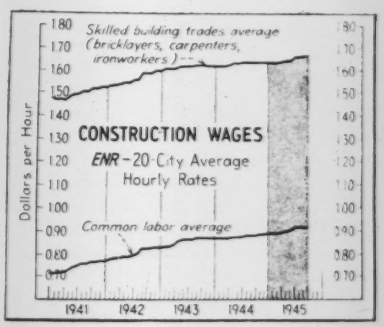
ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	Construction Cost 1926	Building Cost 1913	Building Cost 1926	Volume 1913	Volume 1926
Sept., 1945	309.28	148.67	240.07	129.77	.....	.....
Aug., 1945	309.08	148.57	239.94	129.70	119	52
July, 1945	308.99	148.53	239.64	129.54	119	52
June, 1945	308.99	148.53	239.37	129.40	133	58
May, 1945	307.43	147.78	238.46	128.90	93	41
April, 1945	306.43	147.30	238.46	128.90	99	43
Mar., 1945	304.50	146.37	237.85	128.57	103	45
Feb., 1945	303.70	145.99	237.71	128.50	78	34
Jan., 1945	302.50	145.41	236.51	127.85	63	28
Dec., 1944	302.30	145.32	236.51	127.85	66	29
Nov., 1944	301.09	144.73	236.10	127.63	74	33
Oct., 1944	301.06	144.72	236.00	127.57	91	40
Sept., 1944	300.46	144.43	236.00	127.57	85	37
Aug., 1944	300.42	144.41	236.09	127.62	121	53
1944 (Av.)	298.64	143.59	234.73	126.89	96	42
1943 (Av.)	289.95	139.38	228.75	123.66	176	77
1942 (Av.)	276.31	132.82	222.39	120.22	553	243
1941 (Av.)	257.84	123.95	211.46	114.32	375	164

MATERIAL SHIPMENTS . . . . BUILDING PERMITS

	August 1944	August 1945	% Change	July 1945	% Change July-Aug.
Steel (% operating capacity) A. I. S. I	95.8	78.7	−17.7	90.1	−12.7

	July 1944	July 1945	% Change	Seven Months 1944	Seven Months 1945	% Change
Fabricated structural steel, tons, A. I. S. C.	45,328	51,465	+13.6	302,926	401,343	+32.6
Cement, thous. bbl., U. S. B. of M.	9,283	10,283	+10.8	51,117	53,975	+ 5.4
Building Permits, 215 cities, Dun & Bradstreet (,000 omitted)	$72,003	$89,001	+23.6	$493,755	$380,408	+29.8



COST OF LIVING INDEX . . . . CIVIL NON-AGRICULTURAL EMPLOYMENT

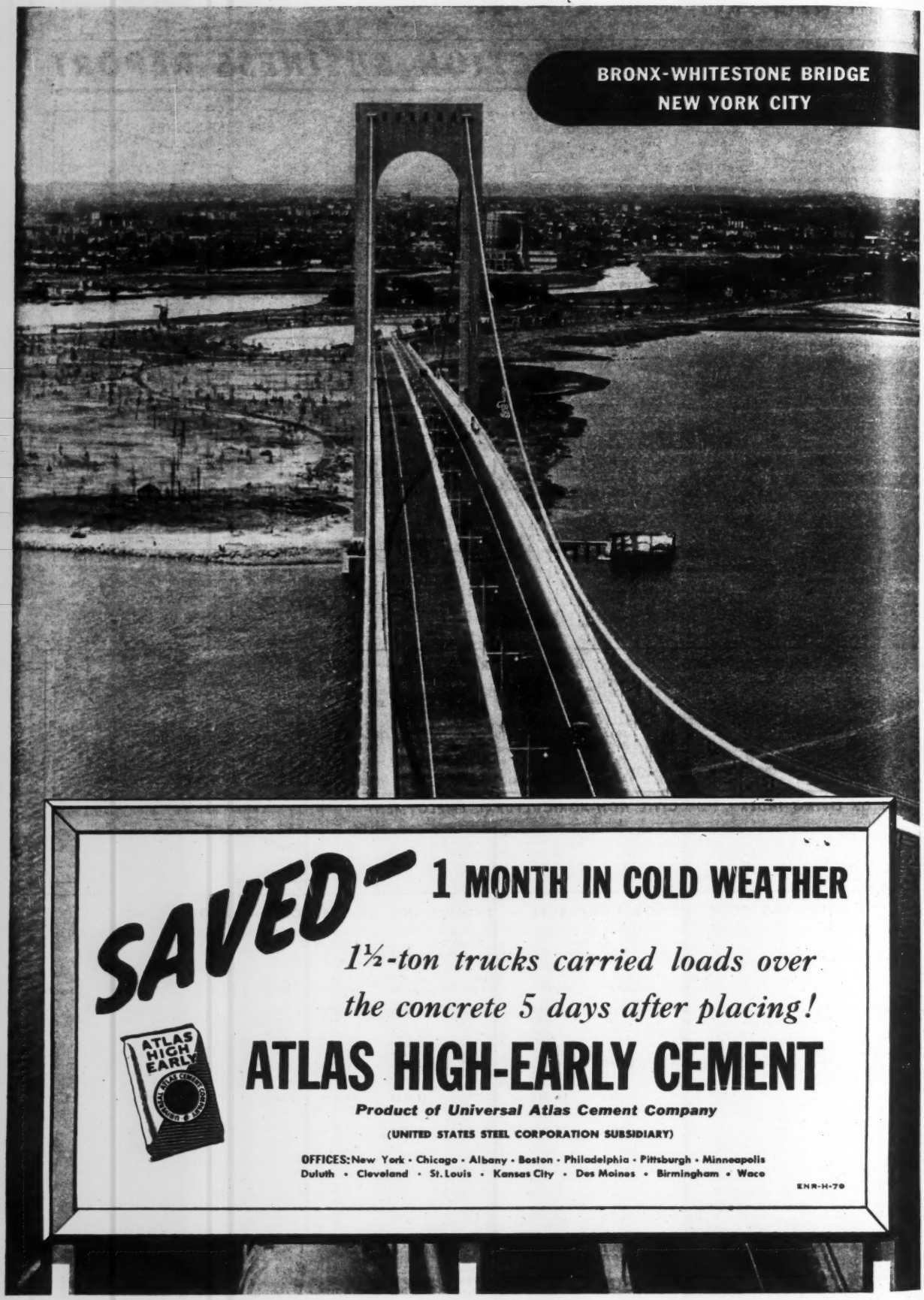
	July 1944	July 1945	% Change	June 1945	% Change June-July
Cost of Living Index, N. I. C. B.	105.0	106.9	+1.8	106.9	0
Rent (Housing) Index, N. I. C. B.	90.9	91.0	+0.1	91.0	0
Total Employment (est.), thous., B.L.S.	38,731	37,177	−4.0	37,556	−1.0
Constr. Employment (est.), thous., B. L. S.	688	901	+31.0	848	+6.0

ENGINEERING CONSTRUCTION CONTRACTS — ENGINEERING NEWS-RECORD — AUGUST, 1945

Engineering News-Record *reports continental U. S. Construction projects of the following minimum costs—waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000

Five Weeks—Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States August 1945	United States Eight Months 1945	United States Eight Months 1944	Canada
Public Works										
Waterworks	338	212	585	425	1,265	7,479	10,304	35,416	21,065	389
Sewerage	265	516	930	975	911	947	4,544	21,440	20,963	335
Bridges, public	22	174	1,034	77	757	628	2,692	18,581	8,411	238
Earthworks and waterways	159	320	393	756	2,471	5,379	9,478	33,016	47,534	473
Streets and roads	828	3,622	5,280	7,339	6,898	1,531	25,498	147,137	145,008	1,698
Buildings, public	1,958	5,800	4,115	4,504	17,198	14,126	47,701	399,922	464,175	10,928
Unclassified, public	2,063	6,032	2,281	1,160	2,045	4,900	18,481	211,676	282,780	279
Total public	5,633	16,676	14,618	15,236	31,545	34,990	118,698	867,188	989,936	14,340
Federal government (included in above classifications)	3,311	7,617	7,639	4,465	19,689	30,715	73,436	648,308	821,911	.....
Private										
Bridges, private	.....	100	.....	.....	.....	.....	100	3,806	1,357	.....
Industrial buildings	3,914	15,470	8,582	18,917	9,086	5,509	61,478	263,686	122,519	3,845
Commercial buildings	1,416	3,820	1,550	1,060	1,880	9,438	19,164	78,005	108,819	1,423
Unclassified, private	225	910	4,983	603	6,697	1,102	14,520	48,414	39,011	50
Total private	5,555	20,300	15,115	20,580	17,663	16,049	95,262	393,911	271,706	5,318
Total Engineering Construction:										
August, 1945 — 5 weeks	11,188	36,976	29,733	35,816	49,208	51,039	213,960	.....	.....	19,658
July, 1945 — 4 weeks	9,594	25,077	33,090	24,052	31,627	47,544	170,984	.....	.....	22,934
August, 1944 — 5 weeks	3,904	30,751	27,786	24,288	47,778	76,744	211,251	.....	.....	13,038
Eight Months — 1945	58,700	182,438	214,646	198,008	278,976	328,331	.....	1,261,099	.....	98,796
Eight Months — 1944	33,653	194,203	211,803	156,399	211,966	453,618	.....	.....	1,261,642	71,555



SAVED— 1 MONTH IN COLD WEATHER

1½-ton trucks carried loads over the concrete 5 days after placing!

ATLAS HIGH-EARLY CEMENT

Product of Universal Atlas Cement Company

(UNITED STATES STEEL CORPORATION SUBSIDIARY)

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ENR-H-79

The Week In Engineering and Construction

ENGINEERING NEWS-RECORD • SEPTEMBER 6, 1945 • VOLUME 135 • NUMBER 10

Sues building union for $3,100,000

A total of $3,100,000 is sought from the AFL International Hod Carriers Building and Common Laborers' Union, Washington, D. C. in two cases instituted Aug. 28 in the district court of the District of Columbia. Local Union 147 of the New York City area, commonly the "Sandhogs' Union," is seeking $500,000 and 260 members of Local 147 want $10,000.

Local 147 claims that it was expelled in 1942 by the parent union without proper cause and that it was supplanted by Local No. 8 without good reason. It is also claimed that New York and New Jersey contracting firms were instructed to deal with the new local. Local 147 also points out that the courts of New York State in 1942 ruled that its charter was illegally cancelled and that the charter issued to Local 8 was void. (*ENR, March* 22, *vol. p.* 370).

Other defendants named include: Local Union 8; Joseph V. Moreschi, and James Bove, president and former vice president, respectively of the parent union; and Harry B. Talbot, president, James Kenny, Jr., and Joseph Maddem, all officials of Local 8 of the union.

Highway building controls eliminated by the WPB

All types of roadbuilding, including bridge work, permitted to go ahead — Emergency must be declared ended, however, before federal aid becomes available.

Late this week or early next the War Production Board will eliminate completely WPB order L-41-E, which is the general control on highway construction.

This action will allow road projects to proceed regardless of cost without WPB authorization. Work freed of control includes bridge building, grading, paving and all other types of highway construction.

Follows earlier relaxation

Early in August L-41-E was relaxed sufficiently to permit public highway and street projects costing up to $100,000 to be undertaken without WPB approval (*ENR Aug.* 16, *vol. p.* 195). Previous to this time, only projects exempt from the necessity of obtaining authorization were those costing no more than $10,000 or those costing $5,000 or less per mile if the total amount of the work did not exceed $25,000.

WPB decided to remove the control completely at this time for three reasons. These are:

Highway construction requires few critical materials; those materials now short in supply are expected to be available in large amounts fairly soon; and present removal of controls will permit more definite planning by state highway departments, county engineer offices and city governments for starting contemplated road construction, thereby permitting this type of work to provide the maximum amount of employment at the earliest possible date.

Elimination of the order also frees the personnel of the state highway departments and the federal agencies employed on getting priorities and authorization for road projects. This release will be welcomed by many highway departments in view of small planning staffs.

Complete elimination of L-41-E is expected to result in considerable road construction during the remainder of this year and a big volume next year. However, it is pointed out that the federal aid provided in the highway act of 1944 will not become available until the war emergency is declared ended by Congress or the President. This declaration is expected soon.

Completion of postwar highway projects in Wyoming expected to cost $25,000,000 will increase the value of the state's system to $100,000,000, it was disclosed recently by J. R. Bromley, Wyoming highway superintendent. The system will bring an annual income of about $4,100,000, he estimated, of which $1,000,000 will be used for maintenance. Income would be $3,000,000 from the gasoline tax, $600,000 from licenses and $500,000 from compensatory fees.

Plans are speeded for 43-mi. Palisades Parkway

Engineering plans are now being drawn for an $18,500,000, forty-three-mile parkway, to start from the New Jersey end of the George Washington Bridge over the Hudson River, traverse the top of the forested Palisades northward, eventually providing motorists easy access to the more remote sections of Palisades Interstate Park.

The project, first announced in 1941, now needs only appropriations by the legislatures of New Jersey and New York to provide funds for construction and the remaining rights-of-way required. These appropriations will be sought next winter with the expectation that actual work may start some time in 1946.

Plans for the New Jersey section of the proposed parkway are being prepared by two firms of engineers and landscape architects: Ammann & Combs and Clarke, Rapuano & Holleran. Gilmore D. Clarke, of the latter, was superintendent of construction of the Bronx River Parkway and later landscape architect for the Westchester, N. Y., County Park Commission, while Othmar H. Ammann, of the former firm, was chief engineer for the Port of New York Authority when the George Washington and other big bridges in the New York City metropolitan area were constructed.

These firms on Aug. 7 signed contracts with the New Jersey Department of Highways for $180,000—half to be paid by the state and half by the Public Roads Administration—to prepare the plans. At 1940 prices, construction of the New Jersey portion has been estimated at $4,500,000.

For the last year Ammann & Combs have also been working on plans for

(*Continued on p.* 80)

State and city construction programs

Among many plans for early construction to aid the postwar economy, promote employment and provide needed improvements are the following:

Columbus, Ohio: Metropolitan Committee for Jobs and Progress has recommended a $24,700,000 public building and development program to be submitted to voters Nov. 13.

The 16-point program would be financed by 15 bond issues and one operating levy. Largest single item calls for $6,500,000 for modernization and construction of new schools in Columbus, including seven new buildings.

Largest Franklin County project is the $4,500,000 memorial auditorium. Other county improvement projects call for $1,500,000 for new trunk sewers; $1,500,000 for a new wing to the courthouse; $1,250,000 for new childrens' home; $400,000 for expansion of the county home hospital, and $350,000 for expansion of the county tuberculosis hospital. The Columbus development program includes $3,500,000 for new sewer facilities; $2,000,000 for a modern sewage disposal plant; $650,000 for street improvements; $500,000 for a health center and safety building; $775,000 for playgrounds and recreational facilities; $200,000 for garbage incinerator; $575,000 for equipment.

Texas: The highway commission has approved for construction in the next 12 months 821 miles of primary highways and 2,162 miles of secondary roads, estimated to cost $53,000,000 and ready to be started whenever Washington approves.

Chairman John S. Redditt said the commission also has approved 1,624 miles of primary road and 4,358 of secondary routes to be constructed in the two following years at a cost of $100,000,000, making a $153,000,000 three-year postwar program.

Plans for the first year's construction are about completed. The commission asked its engineers to proceed with preparation of plans on the second and third year programs, and called upon cities and counties to begin buying rights of way on designated routes.

The commission asked Dallas city officials to furnish right of way promptly for the big Central Boulevard project which will carry traffic north and south. The state also agreed upon a location for the multi-million dollar east-west trafficway, to be built later.

Toronto, Ont.: Almost $9,000,000 worth of postwar construction was unanimously approved by the Toronto City Council at its meeting on Aug. 24. At its next meeting the council will consider a major street extension project, long discussed, which would add another seven millions to the cost of the works in prospect, if and when approved. By far the largest part of the nine million dollars is for city street improvements. Breakdown of the total is as follows: Public welfare, $700,000; public health, $1,400,000; roads, streets and other public works, $5,041,861; parks, $641,000; public property, $508,000; and street cleaning, $491,000. All construction projects, according to Mayor Saunders, have been approved by the city planning board.

California: A highway building program to cost $115,000,000 has been announced by Charles H. Purcell, director of the State Department of Public Works.

Halmos rejoins ENR in charge of news desk

Eugene E. Halmos, Jr., who took leave of absence from the *Engineering News-Record* editorial staff in February, 1943, to enlist in the Air Corps, has rejoined the staff as news editor. T. D. MacGregor, who has been handling the news during Mr. Halmos' absence, will continue to assist him.

Mr. Halmos, who was a navigator on a B-24 Liberator that was shot down

over Germany in 1944, spent ten months in German prisoner-of-war camps before his liberation last April. Entering the Army as a private he was commissioned as a second lieutenant one year later, and last month was retired from active status with the rank of first lieutenant in the Army Air Corps reserve. He is a holder of the Army Air Medal.

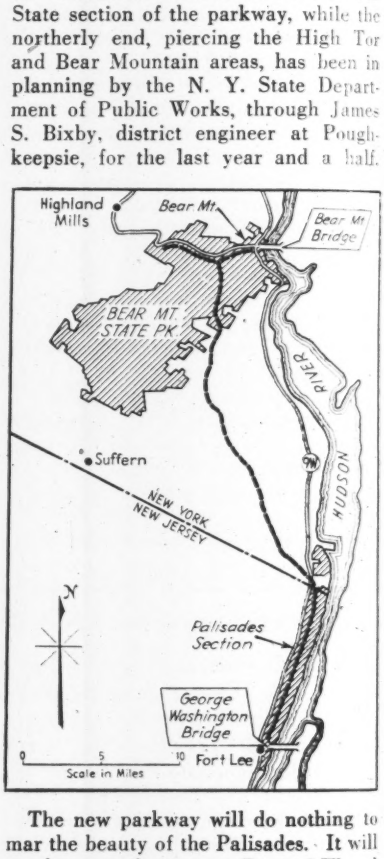
Prior to joining the *News-Record* staff in 1942 Mr. Halmos served as reporter and editor on several newspapers in the west where much of his work centered on land reclamation activities. For three years he was aviation editor of the Standard News Association of New York.

He is the son of Eugene E. Halmos, an associate since 1912 of Parsons, Brinckerhoff, Hogan and MacDonald, New York consulting engineers.

Accelerate plans for Palisades Parkway

(*Continued from page* 79)

the southern stretch of the New York State section of the parkway, while the northerly end, piercing the High Tor and Bear Mountain areas, has been in planning by the N. Y. State Department of Public Works, through James S. Bixby, district engineer at Poughkeepsie, for the last year and a half.



The new parkway will do nothing to mar the beauty of the Palisades. It will run between the present Route 9-W and the edge of the river—at least 200 ft. in from the cliff and in some places as much as 1,600 ft. It would swing inland at the proposed Greenbrook Lake, then return eastward, and finally curve west to join the more inland section of the park, recrossing 9-W.

Two northbound and two southbound lanes are planned, separated 30 ft. at bridges and up to more than 200 ft. elsewhere. Space would be left for a third lane in each direction, perhaps to be used a decade hence. Lanes would be 12 ft. wide, plus shoulders.

Plan expanded study of Texas water supply

Planning an extended and thorough investigation of the state's surface water supply resources, the Texas Board of Water Engineers has announced it will hire additional engineers and purchase further equipment.

A recent appropriation, raising the board's income from $150,920 to $235,490 for the biennium beginning September 1, will permit an expanded staff, the board said.

Investigations will include projects for conserving and using water of the Trinity, Sabine, Neches, San Jacinto, Brazos, Colorado, Guadalupe, Nueces, Canadian, and Red Rivers and the Rio Grande, plus their tributaries and smaller streams. Increasing supply problems of many Texas cities which are already hard pressed to find sufficient water, prompt the surveys.

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FWA cancels 151 jobs costing $18,000,000

As a result of the end of the Japanese war, 151 projects estimated to require an expenditure of over $18,000,000 for construction have been cancelled by the Bureau of Community Facilities of the Federal Works Agency, according to George Field, commissioner of the bureau. Planned for war-impacted centers, the cancelled work consists of jobs already financed but for which no contracts have been awarded.

Some 40 of the cancelled projects were to be financed entirely with federal money provided by Congress in accordance with the Lanham Act. This construction was expected to cost $3,900,000. The remaining 111 projects were joint federal-local undertakings with an estimated cost of over $14,300,000. About fifty percent of this expenditure was to be federal money.

As of July 31 the Bureau of Community Facilities had under construction 511 projects with a total estimated cost of $133,500,000. Of this work $42,000,000 is financed entirely by the federal government with funds made available nearly a year ago. The remainder is made up of projects financed in part by local government agencies. Most of the projects, which include schools, water supply extensions, sewage treatment facilities, and playgrounds, were 75 or more percent complete when the war ended. Because the local communities have requested that the Bureau of Community Facilities do so, almost all of this construction is expected to be carried to completion.

Attack Illinois superhighway act

Illinois' Superhighway Act of 1943 has been ruled unconstitutional by the Sangamon County Circuit Court, which also ordered removed from office the five members of the Illinois State Superhighway Commission appointed under the act. Notice has been filed with the circuit court that an appeal from the decision will be filed with the Illinois Supreme Court. The case is expected to be heard this month.

The case was instituted June 8 on the complaint of Illinois state's attorney John M. Curran, to test the legality of the act. The circuit court's adverse ruling was based on the following points:

"The act gives to the commissioners unlimited and arbitrary power beyond the scope of any right in the legislature or, in this court's opinion, the intent of the legislature. . . . It sets up a super-government responsible to nobody and whose acts are reviewable by nobody."

"The act is not understandable and an attempt to interpret it leads to confusion and uncertainty. It is not complete in itself and this court cannot supply omissions in order to hold the law valid. . . . The scope of the commission's conduct is unlimited and the act provides no means of appeal or review. Moreover, it amends or repeals parts of acts which have been on the statute books for years without any reference to them."

Plans for 10 superhighways

Up to the date of the order of its dissolution, the Illinois State Superhighway Commission had fostered the preliminary study of seven sections of toll superhighways in the Chicago urban area, and three located in Illinois outside of Chicago. A study of these routes was prepared by Allied Engineers, Detroit, Mich., and submitted to the superhighway commission in December, 1944.

Only three of the seven urban routes were considered feasible for construction as toll highways, according to the report, and only one section, the proposed Northwest Route from Orleans and Erie Streets to Bryn Mawr Avenue and Northwest Highway, was deemed possible of 100 percent financing by the issuance of toll highway bonds.

The three rural toll superhighways included in the report are the North Cross-State Route from Chicago to Rockford, Ill., a distance of 65 miles; the 155-mile long South Cross-State Route from East St. Louis, Ill. to the Indiana state line near Terre Haute, Ind.; and the Chicago-East St. Louis Route covering a distance of 269 miles and approximately paralleling U. S. Highway 66. None of these three rural toll highways could be financed, however, without a large proportion of the funds being obtained from sources other than the sale of toll superhighway bonds, according to the report.

Members of the Illinois State Superhighway Commission, appointed by the governor of Illinois are: John J. Schommer, chairman; Charles A. Jean, E. I. Simmons, G. Harder Binz, and William M. Marks.

Equipment prices up eleven percent from 1939

Prices of major types of new construction machinery averaged about 11 percent higher at end of June, 1945, than in August, 1939, according to the Bureau of Labor Statistics' index of construction equipment. The rise was revealed by extensive data collected from manufacturers producing about 90 percent of the total machinery made in 1941.

The survey shows that prices began to advance shortly after the outbreak of the war in Europe and moved upward through January, 1942, mostly during the first 11 months of 1941. After January, 1942, prices remained relatively stable through June, 1945.

Of the nine groups into which the construction machinery is classified by the Bureau of Labor Statistics, the greatest price rise was for track-type tractors, totalling 15.8 percent. Other increases according to types and on a percentage basis were as follows: Tractor-mounted equipment, 9.7; specialized equipment, 11.2; construction materials mixers, pavers, spreaders and related equipment, 5.7; construction material processing equipment, 14.5; power cranes, draglines, shovels and related units, 10.4; and scrapers, maintainers, and graders, 7.5.

No increase in price of drilling and boring machinery was revealed, the cost of this equipment remaining at the 1939 level. Also, the price of portable air compressors dropped 2.1 percent between 1939 and June of this year.

Copies of the detailed report on the survey may be obtained without cost from the Bureau of Labor Statistics, Department of Labor, Washington, D. C.

ENGINEERING SCHOOL NEWS

Immediate construction of a $700,000 building by Rochester N. Y. Institute of Technology as a part of a $2,220,000 program of expansion is announced by James E. Gleason, chairman of its board of trustees. The new building, to house broadened facilities, will be of three stories and basement to provide approximately 100,000 sq. ft. of floor space. It will be fireproof, of simple design, of concrete slab and brick construction with Indiana limestone trim and steel sash. No outside architectural or engineering services will be required, it is announced, as the work will be carried on by the Institute staff members with the advice of engineers and architects of Eastman Kodak Co. and John B. Pike & Son, Inc. The latter firm has the contract for erection of the building.

Establishment of a "training within industry" program at Illinois Institute of Technology was announced recently by Dr. Henry T. Heald, president. Prof. A. G. Giles of the department of technical drawing and co-ordinator of the extension courses, said that "the underlying purpose of this activity is to assist industries in meeting their post-war manpower needs by training men to make the fullest use of their skills." Approximately 30 courses of training in engineering science and management will be offered.

A total registration of almost 18,000 students in the five defense and war training programs offered from 1942 to 1945 by New York University as part of the government's Engineering Science, and Management War Training Program (ESMWT) has been reported by Dean Thorndike Saville of the college of engineering.

Wayne University and the Builders' and Traders' Exchange of Detroit, Mich., in cooperation with the Veteran's Administration have practically completed the program for a course to train returned veterans to become construction engineering estimators.

Three years combination of selected courses in the civil engineering department of Wayne with supervised training half days in contractors' organizations are included.

The Sanitary Engineering and Public Health Research Council of Texas has been founded at Austin by engineering deans of Texas colleges to carry out a broad program of co-ordinated research in sanitary engineering and public health. It was created from a former council made up of college representatives and industrialists.

Members of the new council are drawn from research heads of Texas colleges and public-fund-supported agencies. The council, meeting quarterly, will serve to develop new research and act as a clearing house of information.

The first step in the University of Washington's projected $4,500,000 program for its College of Engineering has been approved by the Board of Regents with the award of two contracts, one of which is for construction of a wing of the engineering building. A spokesman for the university said work on the two buildings, the first to be constructed since 1939, will begin this Fall. The second structure is a kiln building for the College of Mines.

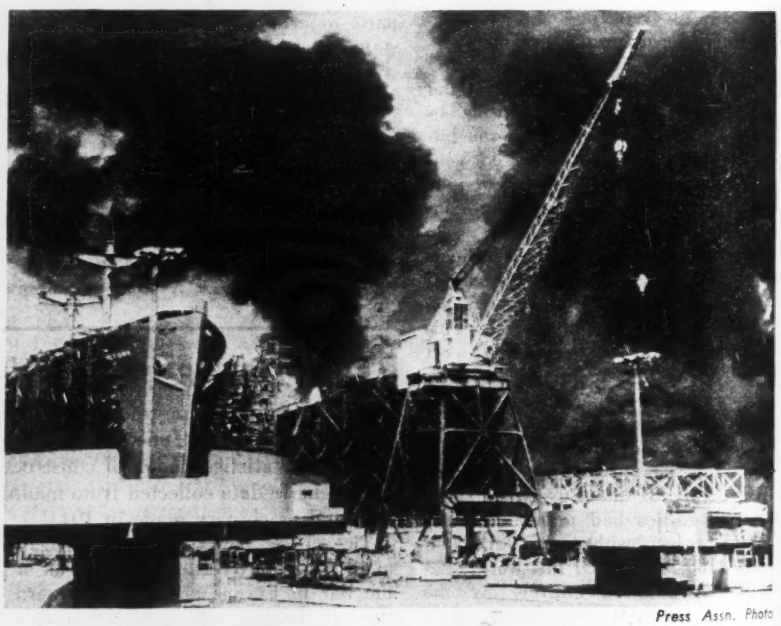
Graving dock and pier planned at Los Angeles

Test borings on the site for a proposed $12,000,000 Navy graving dock and mole type pier are being taken at Terminal Island, Los Angeles Harbor, and sent to Washington, D. C. for analysis to determine foundation designs, it was announced late in August.

Capt. H. E. Wilson, public works officer, Naval Operating Base, San Pedro, disclosed that plans and specifications for the dock and pier are being prepared by the Bureau of Yards and Docks and that contractors' bids are expected to be opened by the end of this year.

The drydock will be 1,100 ft. long by 155 ft. wide, the same size as the present Morcell Drydock, and will be able to handle the largest ships afloat.

Part of the project will be a $4,000,000 mole type pier, inclosed by interlocking, sheet steel pile cells. The new pier will require 1,000,000 cu. yds. of dirt fill to be dredged from the bottom of the harbor, 11,500 ft. of railroad tracks and 50,000 sq. yds. of paving.



Press Assn. Photo

Damage of $3,000,000 in Kaiser shipyard fire

Touched off by a spark from a welder's torch, fire raged through the yards and docks of the Kaiser Oregon Shipyards at Portland, Ore., last week, destroying an outfitting dock, several pipe, paint and tool shops, and spreading to some 25 ships on the ways and at the docks. Four large cranes crashed to the water when supporting docks burned beneath them.

The fire was brought under control after four hours. Preliminary estimates placed total damage at $3,000,000. Most of the ships on the ways were so lightly damaged that repairs and reoutfitting can be made with almost no delay. Kaiser officials said they do not plan to rebuild the damaged sections of the yard. The yard will complete building three ships now on the ways, and other vessels will be outfitted at other Kaiser plants nearby.

Extensive public works planned in California

Working plans for $381,695,000 in California public works are now "on the shelf or being prepared," it is estimated by the California State Reconstruction and Reemployment Commission.

Distribution of the total is: State projects, $171,158,000; county projects, $20,192,000; city projects, $94,577,000; Federal projects, $78,023,000, and projects for special districts, including school districts, $17,745,000.

California has greatly increased its reserve of public funds to aid postwar employment, according to A. Earl Washburn, deputy director of the commission. State and local governmental agencies will have over $500,000,000 for postwar employment-providing projects. The State Legislature, on recommendation of Gov. Earl Warren, has appropriated or earmarked $300,000,000 to help provide postwar employment, to aid returning veterans and to build public works. The $300,000,000 figure does not include an estimated $80,000,000 in revenues from State gasoline tax to be used for postwar highways.

California flood project under way

California's multi-million dollar flood control project swung into positive forward motion late in August with the release of $1,700,000 in planning monies to the Army Engineer. The funds had been impounded by the Bureau of Budget since shortly after appropriation by Congress in the 1944 Flood Control Act.

Immediately after announcement that the money is available, Col. Lester Rhodes, Sacramento district engineer for the Corps of Engineers, said that within 24 hours after money was received in California, surveys would be underway and plans speeded for 15 major flood control reservoirs and other works eventually slated to cost $440,000,000 under latest plans. Contracts would be let at once to private contractors for exploration of project sites and aerial mapping, he said.

Impounding of the $1,700,000, reportedly effected because of indecision as to whether the Corps of Engineers or Bureau of Reclamation should construct the projects, had created a sore spot in minds of water-conscious Californians in the large Sacramento and San Joaquin Valleys.

Apparently to clarify "misunderstanding" over the Engineers' program in relation to the Bureau of Reclamation's vast Central Valley Project, the War Department, in announcing release of the planning funds, said it was "going to work closely with the Bureau of Reclamation in designing the projects so that all water users will be taken into consideration." (*ENR* Aug. 16, 1945, p. 207).

Earlier, Major Gen. Thomas M. Robins, deputy chief of the Corps, told a Sacramento audience that the Engineers' program for the state's Central Valley was coordinated with Bureau of Reclamation plans in every way for multiple-purpose use.

Authorized for construction in the 1944 Flood Control Act are reservoirs and levees costing $150,000,000, but subsequent plans announced by the Pacific Division Engineers last May call for additional works making a total of $440,000,000 (*ENR* June 7, p. 794).

Col. Rhodes said first work probably would be done at Pine Flat, Isabella, Kaweah and Terminus dam sites in the San Joaquin Valley, and at Folsom and Iron Canyon Dam sites in the Sacramento Valley. The Iron Canyon site, on the Sacramento River was selected as an alternate for the controversial Table Mountain Dam.

Sacramento district engineers disclosed on Aug. 30 that exploratory work already was under way at Folsom Dam on the American River, Iron Canyon on the Sacramento, Isabella on the Kern River and Pine Flat on Kings River. The four ultimately will provide storage capacity totaling nearly 3,000,000 ac. ft.

Low level dams at these sites originally were proposed by the engineers, but plans later were changed to provide bases for high-level, multiple-purpose dams as advocated by the Bureau of Reclamation whose huge Central Valley project in the same territory is on the road to completion.

JOBS OF THE WEEK

PLANT ADDITIONS, Fort Wayne, Ind.

Spicer Mfg. Co., Toledo, Ohio, has awarded the contract for the construction of a 1-story, 400x500-ft. factory, 50x100-ft., cafeteria and a 50x300-ft. office building, all brick, concrete and structural steel, to Wermuth Inc., Fort Wayne. The estimated cost is $1,250,000. A. Bentley & Sons, Toledo, are the architects.

OFFICE BUILDING, New York, N. Y.

Haswin Corp., Rockefeller Plaza, Inc., New York, N. Y., has awarded the contract for the construction of a 33-story office building, to be known as Esso Building, at 15-21 West 51 St. and 14-36 West 52 St., to John W. Harris Associates, Inc., New York, N. Y. The estimated cost is $6,000,000. Carson & Lundin, care of owner, and W. K. Harrison, New York, N. Y., are the architects. R. Pollock and Douglas Grieve and Lockwood-Greene Engineers, Inc., New York, N. Y., are the engineers.

FLOODWALL, Portsmouth, Ohio

U. S. Engineers, Cincinnati, received the lowest bid for constructing No. 4 of Portsmouth-New Boston Ohio River floodwall, extending 1½ mi. eastward from east end of present Portsmouth wall to West St. in New Boston, from Dravo Corp., Pittsburgh, Pa., at $854,892.

PLANT, Elkton, Va.

Merck & Co., Inc., Rahway, N. J., has awarded the contract for the construction of 3 additions to the Stonewall Plant, to Merritt-Chapman & Scott Corp., New York, N. Y., at about $3,000,000.

ADMINISTRATION and LABORATORY BUILDING, Inyokern, Calif.

Peter Kiewit Sons Co., Los Angeles, was the lowest bidder at $5,166,600, for administration and laboratory building, at Ordnance Testing Station, when the Bureau of Yards & Docks, Navy Department, Arlington, Va., opened bids.

CONVERTING AUTOMOBILE FACTORY, Los Angeles, Calif.

Swinerton & Walberg Co., Los Angeles, has been awarded the contract for converting automobile factory, by General Motors Corp., South Gate, at approximately $1,500,000.

Note—Additional bidding and contract news on many projects large and small, including the above items, appear in the Construction News section beginning on page 233.

Army Engineers plan four Snake River dams

Construction of four high dams costing about $124,000,000, including power facilities and navigation locks, composes the Army Engineers' latest plan for development of the Snake River in southeastern Washington and Idaho, it was disclosed recently. Previous plans called for ten low navigation dams.

OBITUARY

William R. Shea, 41, Fort Wayne, Ind., project engineer with the Indiana Highway Department, died Aug. 11.

Col. John Stewart, 65, director of works for the Century of Progress, Chicago, in 1933 and 1934, died Aug. 20. He served as a colonel in the Army Engineering Corps during World War I. Recently he was associated with the National Aeronautical Research Laboratory, Washington, D. C.

Charles E. Boyd, 75, president of the B. H. Construction Co., Massillon, Ohio, vice president of the Stark County Construction Council, died Aug. 17.

John W. McManus, 66 of Moncton, N. B., an engineer and contractor, died Aug. 12. He was graduated in civil engineering from the University of New Brunswick and joined his father, the late John W. McManus, in general contracting. He moved to Moncton 25 years ago and continued in contracting on his own account.

Garwood Ferguson, 69, for 30 years engineer for Passaic County, N. J., died Aug. 28. Mr. Ferguson, who retired as county engineer in 1943, had also served several North Jersey boroughs as engineer and previously had been connected with the Erie and other railroads.

Philip C. B. Hervey, 86, retired civil engineer died in Calgary, Alta., Aug. 4. He had been associated with the Canadian Pacific Railway on the construction of Calgary and Edmonton Railway.

Walter S. Dole, 77, civil engineer who participated in construction of gas, electric and water facilities in various parts of the United States, Canada, and Hawaii, died Aug. 15 in Los Angeles, Calif.

Rufus A. Doughton, 90, retired pioneer good roads builder of the south and a former chairman of the State Highway Commission of North Carolina, died Aug. 17 in Sparta, N. C.

Fred A. Henning, 59, civil engineer, died in Indianapolis, Ind., Aug. 15. Mr. Henning was a member of the Henry Steeg & Associates engineering firm. He was former president of the Indiana section of the National Society of Professional Engineers. He was a founder of the present traffic department in Indianapolis.

Neeson, Carey die; leaders in public works

Public works engineers last week marked the passing of two leaders in their field, with the death at Philadelphia of John Neeson, the city's director of public works; and at Los Angeles of Charles E. Carey, Western Regional Director for the Bureau of Reclamation.

Mr. Neeson, 61, entered Philadelphia's service in 1906, and was later in charge of construction of the city's two airports. From 1928 to 1940 he was chief of the Bureau of Engineering, Surveys and Zoning, and in 1931 was elected president of the American Society of Municipal Engineers. He was appointed as director of Public Works in 1940.

Mr. Carey, 55, was in charge of the Central Valley Project in the San Joaquin Valley of California, and at one time was administrator of Bonneville Dam at Portland, Ore. He was a former head of the power division of the Bureau of the Budget in Washington, and had taught electrical engineering at the University of New Mexico.

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Col. Renshaw decorated for building Pentagon

Col. Clarence Renshaw, Army Engineer, has been awarded the Legion of Merit for: "Service in connection with the war construction program, initially under the the Quartermaster General, and later as area engineer in charge of construction of the Pentagon building, Arlington, Va. He rendered outstanding services in the office and the field in connection with the construction program and through his leadership, technical ability and sound judgment made possible the early occupancy of the Pentagon."

Built during the early stages of the war to house all activities of the War Department under one roof, the Pentagon is the world's largest office building. Approximately 35,000 employees work under its roof.

Col. Renshaw had an important part, also, in the construction of cantonments for our rapidly expanding Army before and after Pearl Harbor.

A graduate of M.I.T. and West Point, Colonel Renshaw is now district engineer, Philadelphia Engineer District, and he is also a member of the Beach Erosion and Shore Protection boards of the Corps.

Much rail construction planned by China

During the next ten years China plans to construct 20,000 mi. of new railroad, E. T. Shen, Chinese railroad executive now in this country, informed an *Engineering News-Record* representative this week. China will also need to improve much of the 14,000 mi. of existing line, about 90 percent of which is in the coastal area occupied by Japan at the end of the war, according to Mr. Shen, who is traffic manager of the Hunan-Kwangsi Railroad in the Hunan and Kwangsi provinces. The total 24,000-mi. system planned at the end of ten years would compare with about 228,000 mi. now operated in this country, not including inter-urban and streetcar lines.

The new mileage will be built according to the American standard gage, as are most railroads in China. It will be constructed and operated by the Chinese national government, which owns and operates almost all of the existing mileage. Most of the new mileage is planned for the interior of China where transportation facilities are very inadequate. Because of the importance of transportation to the development of those regions, construction of additional railroads and highways will be one of the first Chinese building programs.

In building the new lines extensive financial aid from outside will be necessary, and China hopes to get much of this help from the U. S., Mr. Shen said. Because of the plans to use much local hand labor on construction no total cost figure is given. However, an expenditure of a large amount of American money is anticipated for purchasing rolling stock, rails, and supplies not produced in China in large quantities. The plan is to buy a large proportion of these supplies from the U. S.

China also expects to obtain considerable technical aid from this country and to hire numerous American engineers. At present many Chinese engineers are in the U. S. getting specialized training (*ENR*, Mar. 22, vol. p. 373). Mr. Shen, a University of Pennsylvania graduate, is one of these men.

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Simplified list of rolled shapes proposed

A voluntary Simplified Practice Recommendation for Hot-Rolled Carbon-Steel Structural Shapes, as proposed by the American Iron and Steel Institute will be made available this month by the Division of Simplified Practice, National Bureau of Standards, Washington, 25, D. C., for consideration, comment and approval.

Comment and Discussion

Readers' opinions on matters that concern engineers and contractors

A Level Yarn

Sir: Gleefully I join Henry Welles Durham (*ENR* May 17, 1945) in taking a fall out of Edward D. Hopkins for trying to foist on us (*ENR* Dec. 28, 1944 vol. p. 813) an Inca "Chica bowl" as the forerunner of the hand level.

Inca leveling methods are no mystery and are in use by the Andean cholo to this day. The procedure is simple and had there been engineer handbooks published by the Incas there would have been found a simple explanation as follows:

Notes On Leveling For Irrigation Canals

1. Remove the wool from one or more alpacas according to whether you have a small construction job or a lengthy preliminary survey.
2. Have one of the girls whip up the required amount of yarn.
3. Saturate the yarn with water.
4. Now have the rear chainman hold his end of the yarn against the top of the departure stake which has been set at proper grade.
5. Unroll as much yarn as is necessary to establish your second grade stake.
6. Pull yarn taut and orient vertically until globules of water form and begin to roll slowly down yarn in direction of desired flow.
7. Now orient the yarn horizontally until your end is approximately the same distance above ground as your departure stake.
8. Set stake No. 2.
9. Repeat procedure as outlined above in steps 3 to 8.

GARDNER GANTZ
Senior Civil Engineer
Food Supply Division,
Institute of Inter-American Affairs
Port-au-Prince, Haiti

Goal and Prediction

Sir: You have done the work of the Committee on Postwar Construction of the American Society of Civil Engineers a great disservice in your editorial, (*ENR* Aug. 23, vol. p. 223) by implying that its director was "predicting" an impossible program. I am surprised that *Engineering News-Record* would make such a reference without checking its accuracy with the author.

In your editorial, "Promise and Performance," you said: "Only last week, for example, the director of the American Society of Civil Engineers' committee on postwar construction was reported in an *Associated Press* dispatch from California as having predicted a $15 billion program for the first year after V-J Day; either he was misquoted or is unduly optimistic." The last clause is unmistakable evidence that you doubted the accuracy of the quotation, yet I have no indication of your having attempted to get in touch with me for verification.

The address to which the *Associated Press* referred was made in San Francisco and the statement, if correctly quoted by the *Associated Press*, would have said: "To maintain a high-level of employment based on a yearly income of $140 billion would necessitate an annual construction program of $15 billion."

One might expect a non-technical reporter to confuse a "goal" with a "prediction," but a technical publication should recognize that there is a vast difference between saying that a $15 billion national construction program would be required and saying that a $15 billion program is predicted.

The Committee on Postwar Construction of the American Society of Civil Engineers makes no predictions as to what the construction volume will be, but it has set up a goal of $15 billion and is doing everything within its power to stimulate the preparation of plans to attain this goal at as early a date as possible.

OSCAR L. KING
Director, Committee on Postwar Construction, American Society of Civil Engineers

Any disservice done Mr. King or the committee was, of course, unintentional. As a matter of fact, having checked with his New York office and finding that no copy of his speech was available, we suggested that he perhaps had been misquoted. We are glad to record that he was. However, the point of the editorial is still valid; the construction industry must not promise more than it can deliver in the first year after V-J Day. Mr. King's experience suggests that persons having occasion to use statistics in public addresses should make doubly sure that they cannot be misunderstood.—EDITOR.

Wasteful Bidding

Sir—I have just met up with a formal procedure being practiced by public bureaus which, to my mind, is not only unfair but vicious. Furthermore, if permitted to develop, it will unquestionably lead to higher construction costs. These higher costs will have to be paid for by the taxpayers, for which they will receive absolutely nothing.

Among my clients are several contractors for whom I frequently prepare quantity surveys. This is naturally a source of my income. As is the American procedure, the cost of these estimates is absorbed in the overhead item of estimating. Recently I have been called to prepare estimates from plans, which are distinctly identified as "Not Checked", and do not bear signatures of approval by the issuing bodies. There is no doubt that another estimate will have to be prepared at a later date.

This means that the construction industry with all its many quotations including materials, sub-contract estimates, etc. will be required to pay twice for each estimated project. The cost of this additional work must be borne by "overhead".

Both the architects and engineers engaged to prepare these plans receive the fees to which they are entitled. Then the bureaus, many of whose members are accepted as qualified construction men, call for definite bids on these unfinished, unapproved plans, for which the bidders receive nothing.

The industry today must finance such overhead items as taxes, royalties, permit fees, bonds, etc., far greater than many other business enterprises. Now we bid fair towards having still another overhead item—"Useless bids". Perhaps, however, concerted action by the construction industry can avert this. I hope so.

WALTER F. MASSEY
Consulting Engineer
White Plains, N. Y.

EDITORIALS

VOLUME 135 NUMBER 10

September 6, 1945

Peacetime Conventions

IT HAS LONG BEEN RECOGNIZED that national conventions are a necessary part and parcel of the civil engineering-construction industry. While the recent relaxation of restrictions on conventions of not more than 150 attendance will benefit local organizations it offers no opportunity for the larger groups to assemble and perfect their plans for increased activity. Adequate travel accommodations for returning veterans will continue to hold top priority in transportation for months to come. But just as it has been necessary for ODT to restrict convention travel since February of last year in the interest of the war effort, so is it now imperative that these restrictions be further relaxed in the interest of peacetime employment. And on the part of the convention planners there is the responsibility to arrange useful, down-to-business programs. Too often in the past, conventions, even of engineers and construction men, have not been worth the cost of the maid service required to sweep up the bottle caps.

Bids for Engineering Services

IS THE ENGINEERING PROFESSION in part responsible for the frequency with which cities and towns call for bids for engineering services on a price basis? That question is raised by another such call, this time from St. Augustine, Fla. That city has asked for sealed bids for a complete sanitary survey of the city, for plans and preliminary estimates for a new sanitary sewer system and a sewage treatment plant, for plans and estimates for a new storm sewer system, and for supervision of construction. Some of the firms from whom bids were solicited already have advised the city manager that they will not compete for professional work on a price basis; others may be expected to do so before the bid date of Sept. 24. As a result, the city's effort to get the work done at the lowest possible figure may have just the opposite effect, for it may deprive the city of the services of firms best able to undertake the difficult task of designing most efficiently and economically a sewage system suited to its peculiar needs. Here is a situation that should not be dismissed by saying that the city manager should know better than to call for bids for professional services. Rather, the profession should determine whether an educational program is indicated, to explain the current fundamentals of professional ethics or whether the existing system of rendering professional engineering services needs a critical restudy as to its adequacy for present-day needs.

WPB Kept Its Promise

SOON AFTER THE WAR PRODUCTION BOARD was established in January, 1942, heads of that agency promised all WPB controls on American industry would be removed as soon after the war as possible. Work of the WPB during recent weeks shows that this promise has been kept so far as the construction industry is concerned. In fact, some argue that the controls have been relaxed too quickly. Already, orders L-41 and L-41-E, the controls on general construction and highway work respectively, have all but been eliminated, while the controls on water, gas and electric utility construction are to disappear Sept. 30. Restrictions on the use of lumber have been greatly relaxed, and the few other building supply regulations still remaining are not expected to delay appreciably resumption of civilian construction on a big scale. The WPB is to be complimented on the way it handled its big, difficult job, and particular praise is due its personnel who left their jobs in private industry to work at greatly reduced salaries in war-crowded Washington. They served their country well during the war emergency, a service that will continue on into peace by virtue of their acquired knowledge of governmental operations.

The Full Employment Bill

HEARINGS CURRENTLY BEING HELD before the Senate Committee on Banking and Currency on the so-called Murray Full Employment Bill (S-380) should be followed closely by engineers and construction men. It is their profession and industry that is envisioned as furnishing the *extra* jobs that may be required from time to time to make employment "full". And it will be their responsibility to see that these jobs are of such kind and are carried out in such a manner as to help rather than be a drag on other elements of the economy.

The significance of the bill to the construction industry is not immediately apparent since it refers to construction as merely one of a number

of devices, like interest rates or taxes, that can be manipulated to affect employment. Yet the significance is real, and this rather casual treatment of construction only emphasizes the need for full understanding.

Basically the full employment bill is designed to introduce directed and controlled planning into our private enterprise system. It does this in two steps; first by having accepted as a federal government principle that "all Americans able to work and seeking work have the right to useful, remunerative, regular and full time employment"; and second by requiring the President annually to submit a budget to Congress comparing job possibilities witth employment needs, and accompanying it with a recommendation as to means of making up any job deficits (or, in case the labor force should be less than required, of counteracting inflation). Proponents of the bill emphasize its simple principle, which anyone can accept, while glossing over the complexities and uncertainties involved in making it work.

The language of the bill relating specifically to construction points out that after everything possible has been suggested to encourage non-federal investment and expenditure without assuring sufficient jobs, a federal-aid program shall be recommended. This means public works, and, of course, it means projects over and above the normal programs because the jobs from these have already been taken into consideration.

Where are these extra projects, suddenly demanded, to come from? Unless they are to be of boondoggling type, they must, of course, come from a shelf of already-designed works that have been held for just such a contingency. Thus the full employment bill, if passed, places a premium on continuous advance planning of public works, and gives new prominence and importance to the six-year planning programs upon which a start was made before the war.

In any event the full employment bill needs to be recognized as one of the most far-reaching in possible effects that has been introduced in many a year. As a brave attempt to reduce the peaks and valleys of employment under our private enterprise system it deserves careful, even prayerful, consideration, and particularly so since the procedure it sets up relies so heavily on construction for its successful operation.

First In, Last Out

PEACE IN THE WORLD, official, final and welcome, finds our construction men in uniform, Navy Seabees and Army Engineers, scattered around the world still doing the jobs that made them famous and our victory possible. Before Pearl Harbor they were in the South Pacific building airbases and in the Middle East building roads. Soon they were constructing naval bases in Ireland and bomber fields in England. They rebuilt Pearl Harbor and fashioned runways at Midway from which the planes rose to transform the rising Jap steamroller into a descending toboggan. They turned up in North Africa and Sicily, in India and Burma and then in China. From Australia through New Guinea to the Philippines and from Hawaii through Kwajalein to Guam, their reconnaissance and bulldozers led the way northward and westward toward one enemy, while across the world the harbors of France and Italy, and the bridges and roads as well, felt the lifting force of their crawler cranes and the push and pound of their tractors and pile-drivers as the other enemy was crushed.

More than once the Seabees welcomed the Marines, and the Engineers guided the Paratroops to their first landings. Always these construction specialists were there first, paving the way for the overwhelming power of the military machine that demanded and inspired their efforts. The accounts of what they did there—and how and with what—have a timeless value, as for example Commodore Halloran's article on the tremendous B-29 bases the Seabees built on Tinian Island and the article by *News-Record's* Harold Richardson on the facilities built at Guam, both of which are in this issue.

To chalk up these accomplishments, the Engineers and Seabees not only have to be first in, they have to stay the longest. They are apt to be the last out, a fact that should not be forgotten when we thrill to the concluding sentence in General MacArthur's eloquent address to the nation from the battleship Missouri in Tokyo Bay this week. "They are homeward bound," he said, "take care of them."

Some of "them," our Army Engineers and our Navy Seabees, may be somewhat delayed because military construction has to wind up a war as well as to precede it. First in but last out, these construction men will deserve the utmost in praise and help that a grateful nation can bestow.

ENGINEERING NEWS-RECORD WALDO G. BOWMAN *Editor* **Copyright, 1945, by McGraw-Hill Publishing Company, Inc.**
EDWARD J. CLEARY, *Managing Editor. New York:* V. T. BOUGHTON, H. W. HUNT, E. R. DENMARK, T. D. MacGREGOR and H. P. ORLAND. *Chicago:* H. W. RICHARDSON, J. R. CARR. *Washington:* PAUL WOOTON, A. N. CARTER. *San Francisco:* N. A. BOWERS
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What Blood and Sweat Have Done at Guam

Harold W. Richardson
Western Editor, Engineering News-Record
(By Airmail from the Pacific Theater of Operations)

***Editor's Note**—Recaptured from the Japs a year ago, the island of Guam has been transformed into a mighty bastion for offensive warfare. The role of the Navy, Army and Marine engineers in making this transformation, and a brief outline of their accomplishments, are given in this dispatch from Mr. Richardson, who is now visiting Pacific war fronts.*

D-DAY AT GUAM was July 21, 1944, when Marine and Infantry divisions stormed ashore at two points straddling strategic Apra Harbor in the first move to wrest the island from the Japs after 31 months of enemy occupation. With the assault troops came units of Marine Engineers, Navy Construction Battalions and Army Engineers to construct roads, camps and landing fields.

Just a year later—D + 365—Guam is a mighty bastion in the Pacific, an impregnable island fortress reared by those and other service engineering and construction forces. Guam is the nerve center of the final thrust against the Japanese homeland, for the advance headquarters of the Navy Command have been moved out here. It lies within air striking distance of Tokyo and the Jap empire. It is the hub from which operations in the Western Pacific radiate. It is rapidly becoming a second Pearl Harbor in size and strategic position.

Yet only a few short years ago a timid Congress, backed by public opinion, refused to sanction the fortifying of Guam because of possible offense to the Japanese. Only 45 months ago those same Japanese took the island away from a few gallant defenders as the first American land to be captured. Only 12 months ago we returned with an overwhelming force to recapture the island after three weeks of bloody fighting. Only nine months ago the huge construction

All official U. S. Navy Photos by John Mason, 5th N. C. Brigade

Fig. 1. A B-29 bomber taking off from one of Guam's five airfields symbolizes the island's position as an air center. The five fields contain 50 mi. of runways and taxi strips, mostly asphalt paved with coral aggregate.

rogram really got rolling.

Today the former drowsy island radise is an island of contrasts. Its 5 sq. mi. of rugged mountains, nse jungles and broad beaches are itted with military installations of ery description. Its 22,000 high-ass natives, blasted out of their hatched-roof villages and beautiful apital city of Agana, then enslaved, hen again blasted out by the second nvasion, are trying to resume their eaceful ways amid the confusion of onstruction and war operations.

The extensive, well-built headquar-ers of Fleet Admiral Nimitz and his taff overshadow native huts of abandoned packing cases thatched with palms. Carts pulled by carabao, r water buffaloes, amble by long aved runways while hundreds of B-29 bombers roar off to another trike against Tokyo. Paved roads up to four lanes wide, teeming with mili-tary traffic, cut across age-old mud ruts of oxcart trails. Warships and freighters and landing craft skirt reefs where native boys are calmly fishing.

Neat rows of Quonset huts and warehouses of a permanent military camp face a messy compound where a tired division just returned from farther out is trying to set up a rest camp in freshly-cleared jungle. Ma-teriél by the thousands of tons is be-ng unloaded at the very shores of Apra Harbor where the Pan-Ameri-an Clippers used to taxi ashore on he first Pacific air route.

Guam, destined to become our sec-nd mailed fist in the Pacific, will never be the quiet, peaceful island of old. Today it is enmeshed in the or-ganized confusion of a major operat-ing war base.

Construction at war tempo

Inured as we may be to the size nd speed of wartime construction projects, operations at Guam are still impressive. Gaping quarries testify to the amount of coral removed for building highways, airfields and the harbor breakwater. The coral here is mostly in pockets in igneous rock thrust up long ago to create the island. Some 20,000,000 cu. yd. of coral has been quarried and hauled away, while another 7,000,000 cu.yd. of excavation has been moved in grading roads, airfields and camp sites—and the job is far from fin-ished.

Fig. 2. Busiest intersection on the island, where three roads come together at Agana Bay. These highways are typical of the road network, much of it asphalt paved with coral aggregate.

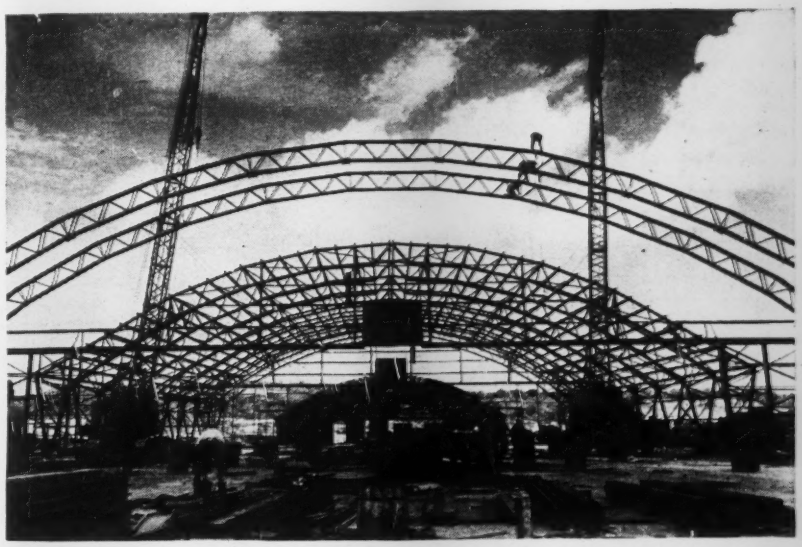


Fig. 3. Big steel hangars at Guam are only for plane maintenance and parts storage, not for plane housing. In the background are two Stran Steel hangars; cranes in the foreground are lifting trusses for an Armco type structure.

Skirting most of the island and connecting the various areas will be 349 mi. of road, 103 mi. of which will be asphalt surfaced and the remainder topped with coral. About two-thirds of the road program is now finished. In the harbor area, where traffic is heaviest, roads are four lanes (44 ft.) wide; elsewhere they are two and three lanes. The wide roads were criticized in some quarters at first as being too elaborate, but today even the superhighways have reached the point of traffic saturation.

Crushing equipment is scarce, screening equipment is non-existent, so much of the road and airfield system has been built up of quarry-run coral, well rolled and packed. The asphalt surfacing is a minimum

Fig. 4. Rows of Quonset warehouses indicate the amount of storage space required for a big war base. *The versatile Quonset serves a multitude of uses.*

Fig. 5. Aircraft and automotive equipment and construction machines must have fuel, so tank farms of one million gallons storage capacity have already been built at Guam.

Fig. 6. One of five big generating plants that produce power to keep the war base in operation. This plant, Quonset housed, contains six 300-kw. diesel units.

Fig. 7. A 10,000-ft. breakwater, containing 2 million yards of coral fill, will protect the north side of Apra Harbor and create a sheltered anchorage for the fleet.

Fig. 8. Coral, some 20,000,000 cu. yd. of it, has been removed from scores of quarries like this for road and airport and breakwater construction.

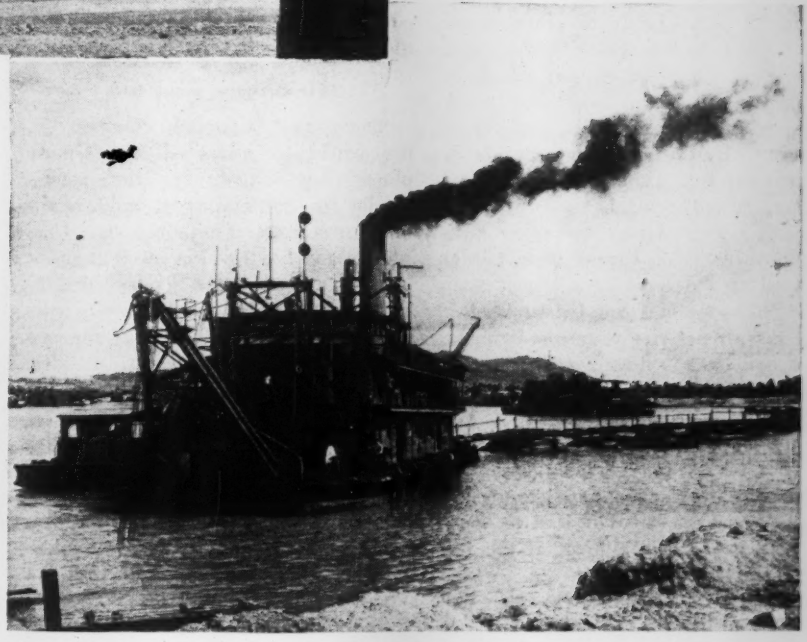


Fig. 9. Apra Harbor isn't big enough or deep enough for its intended use as a naval base, but it will be when these dredges get through their 20,000,000-cu. yd. excavating job.

Fig. 10. Equipment, new and rehabilitated, awaiting shipment to forward areas from the Advance Base Construction Depot at Guam. A big parts storage and supply system is also a part of the base.

of 2½ in. of hot plant mix, with crushed coral as the aggregate. Coral surfacing is only fairly satisfactory, as it ravels considerably under heavy traffic. Incidentally, all concrete poured so far on the island has been made of ungraded crusher-run coral.

In the Pacific air war Guam occupies a most strategic position, and today it is probably the busiest air center in the world. Cargo and transport planes on regular schedules connect the island with the other Marianas, the Marshalls, the South Pacific, Hawaii and the mainland, Okinawa, Iwo Jima and the Philippines. Bombers take off on daily strikes against Japan and other military objectives. Brand new fighter planes are "de-preserved", broken in and flight-tested from Guam fields.

This air activity requires airfields, and five already have been completed with runways and taxiways totaling a shade over 50 miles in length. Asphalt paving of coral aggregate predominates for surfacing, though some taxi strips and hard stands are still coral topped. The first of these fields was an enlargement of the Jap strip on Orote Peninsula, where U. S. Marine Engineers repaired one end of the field while their buddies were pushing the Nips off the other end.

The other four fields, three of them with long dual runways, were laid out in the jungles. Nature never intended Guam terrain as an airbase, so heavy clearing and grading were necessary. On the two largest fields, where deep cuts and high fills are common, this meant moving millions of yards of rock.

Few hangars, many huts

There aren't enough hangars in the world to house all the Guam planes, but hangars are used extensively for maintenance and repair and for storage of repair parts. One field alone has ten big steel hangars —Butlers and Stran-Steels 165x200 ft., and Armcos 195x200—all with asphalt-paved floors. The Seabees delighted the Air Corps with an idea of building two sets of Armcos in tandem to provide clear working spaces 195x400 ft. Incidentally, the hangar designers and manufacturers would be astonished to see some of the structural changes—some necessary, others merely convenient—made by the Seabees in erecting the big steel jobs.

Statistics fail to reveal the exact number of steel huts and frame warehouses on the island, but they run into the thousands. Quonsets predominate, small, intermediate and large sizes, one and two stories, in single, double, angle, crossed and "Mae West" multiple arrangements. They are used for barracks, offices, hospitals, clubs, warehouses, shops and industrial buildings, and even for the barn for cattle supplying milk to the hospitals. They house telephone exchanges and radio stations, they serve as municipal centers, schools and dispensaries in the reconstructed native villages. Truly, Guam is a second Quonset Point, from which these buildings sprang.

Frame structures supplement the Quonsets for warehouses, and in some cases for offices. Another type of steel hut, the Butler, finds favor in some hospital areas. There are four base hospitals set up on the island.

Despite the large number of Quonsets assigned to troop housing, the majority of military personnel on the island, including officers, is still quartered in tents, contrary to optimistic reports recently circulated in the States. Guam may be listed as an island paradise in the tourist

books, but many a trooper housed in a tent between the jungle and a noisy military highway, with the plumbing consisting of helmet washbasins and primitive outdoor latrines, and with bugs and lizards for tentmates, would trade all this paradise for a chunk of the good old U.S.A.

Utilities on large scale

The public utilities planned for the island would serve a community the size of Albany, N. Y., and construction is nearing completion on many of them. A combination groundwater and surface supply has already been developed that will yield 12.5 mgd. treated water. The water supply includes an extensive underground gallery collection system. Water lines so far lead only to the major areas, but they are being constantly extended. At present the only sewage disposal line, ending in an outfall into the ocean, is that serving headquarters. However, other built-up areas are equipped with septic tanks.

Five diesel-drive electric generating stations are being built to produce 11,200 kw., four are already in service. Portable plants meet the remaining current demand. About 10 out of 50 mi. of primary transmission lines have been completed.

Tank farms for almost a million bbl. of gasoline, diesel fuel and black oil storage have already been built, along with 35 mi. of pipeline. Ammunition storage igloos are another big construction item.

Telephone installations include two automatic and six manual exchanges with more than 125 branches. To date there have been built 200,000 ft. of aerial cable and 100,000 ft. of underground phone lines. Radio stations, all Quonset hut housed, have a daily capacity of 10,000 messages, and constitute one of the greatest communication facilities in the world.

Second Pearl Harbor

The extent of developments at Apra Harbor cannot be revealed at this time, but the project has been referred to as a second Pearl Harbor. A 2-mi. coral-fill breakwater, requiring almost 2,000,000 cu. yd. of large rock, is more than half complete. Along the opposite side of the bay an 8-mi. line of 60-ft. sheetpiling defines the harbor shoreline.

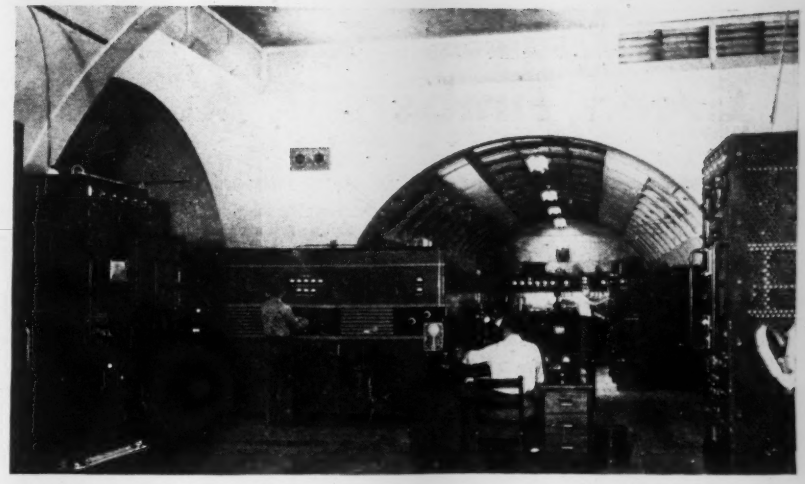


Fig. 11. One of the most important construction jobs for the Seabees at Guam was building this radio station out of several Quonset huts.

Until enough permanent berths can be built, many ships are still being unloaded alongside floating piers and wharves of steel box pontoons. Clamshell and hydraulic dredges are gouging out 20,000,000 cu. yd. of harbor bottom to make way for anchorage and unloading areas. Not so long ago the harbor work alone would have been regarded as one of the world's greatest construction projects.

Equipment-starved contractors in the States would think they were in dreamland to see the amount of construction machinery on this island alone. Great numbers of units, of course, are required to carry out the island construction program. Speed is paramount on this project, so every construction force is amply, but not excessively, supplied with equipment of all descriptions. Each force operates its own equipment and maintains it in its own shops. Then, too, there are thousands of trucks and trailers hauling and distributing supplies and materials.

All this array of equipment, however, is overshadowed by two equipment operations known as ACEORP (automotive and construction equipment overhaul and repair plant) and ABCD (advance base construction depot).

Surplus equipment from the other Marianas, the Gilberts, the Marshalls and other island areas now in the backwash of the war, is shipped to ACEORP for overhaul and repair. Here, in the most extensive repair shops outside the mainland, the units are inspected as to possibility of recovery, and are either junked after all usable parts have been salvaged, or are overhauled and repaired to at least 90 percent of new usefulness. The tire plant in this project has a capacity of repairing 1,000 casings a week.

Across the road, ABCD has even more equipment on hand, for here all the rehabilitated units from ACEORP are received, along with new machines from the mainland and from the European theatre. From this base the entire forward area is supplied with equipment, and from what goes out every day there must be a whale of a lot of construction ahead.

Seabees in charge

While the army and navy both have construction forces on the island, along with small groups of Marine engineers and Coast Guard construction detachments, all construction work is under the general direction of Commodore Charles T. Dickeman, commander of the 5th Naval Construction Brigade and Guam Island Engineer. He has just succeeded Commodore W. O. Hildabidle, Jr., who carried out the construction program from the start. Col. C. J. Jeffus is in charge of all Army engineer battalions on the island.

To date the Seabees have performed 71 percent of the construction work, with the army being responsible for 26 percent and the Marines 3 percent.

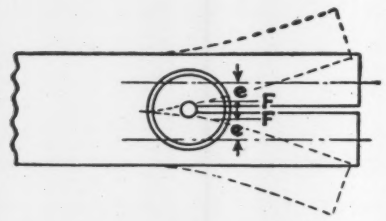
Green Timbers in Australian Structures

Ian Langlands
Timber Mechanics Section, Division of Forest Products
Australian Council for Scientific and Industrial Research

AUSTRALIA has experienced some difficulties in use of green timbers, similar to those recently described in American engineering journals, in a small proportion of the great number of timber buildings erected in this country in recent years.

Green hardwoods, mainly eucalypts (*Eucalyptus* spp.) are used almost exclusively for timber structures in Australia. These hardwoods are dense (40 to 70 lbs per cu. ft. at 12 percent moisture content). They have a relatively high shrinkage 7 percent (from green to 12 percent moisture content) tangential to the growth rings, and in some species the shrinkage is very high, 14 percent (from green to 12 percent moisture content) tangential to the growth rings, due to the incidence of "collapse".

Some years ago, the Division of Forest Products of the Council for Scientific and Industrial Research of the Australian government made a comprehensive series of tests on split ring connectors following the usual technique of testing joints in compression under loads of short duration. All the specimens tested were green when assembled, half being tested immediately after assembly, the remainder being allowed to dry for three years to a moisture content of about 15% before testing.



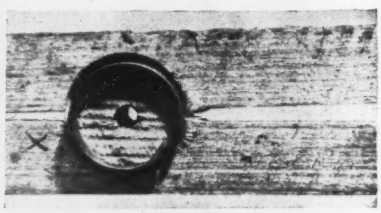


Fig. 2. Failure of tension joint with end-split due to creep. The bending moment Fe causes prong ends to deflect. (Below) Result of tension test on specimen with artificial end-split.

Generally, when the load was applied paraliel to the grain, higher strength values were obtained with the specimens seasoned before testing, even though end checks were prevalent. On the other hand, when the load was applied perpendicular to the grain, a loss of strength occurred in drying. This was found to be due to the shearing of the cores during drying.

From these tests working loads were obtained by dividing by a factor of four (see "Handbook of Structural Timber Design" 2nd. Edition, published by the Australian Council for Scientific and Industrial Research). Experience has shown, however, that the working loads so obtained, although safe under wind and live loads and the usual combinations of wind, live and dead loads, are at least in some cases, unsafe when dead loads only are acting, failure occurring some weeks or months after erection by end splitting and shearing.

The trouble has been most common in the high shrinkage timbers but it has also been found in timbers of normal shrinkage for their density. A typical failure in a tension splice, which occurred some six months after erection under a dead load slightly less than the recommended working load, is shown in Fig. 1.

As described by Mr. Woodruff (*ENR* Oct. 5, 1944) the first sign of trouble in such cases is the presence of end splits that gradually open, finally permitting failure of the joint. Experience has shown that such failures are confined to tension joints but that they can occur at dead loads equal to about 75 to 80 percent of the working load; i.e., they can occur at loads equal to $\frac{1}{3}$ of the average value obtained in short-time compression tests. In no case have failures due to live loads been noted. As shown in Fig. 1, the failures have occurred in tension splices where there is no cross grain component of load and they have also occurred in single bolt joints in members in which the ratio of length to width is 20 or more.

In my opinion, perhaps the major factor in such failures, at least in green hardwoods, is the effect of creep

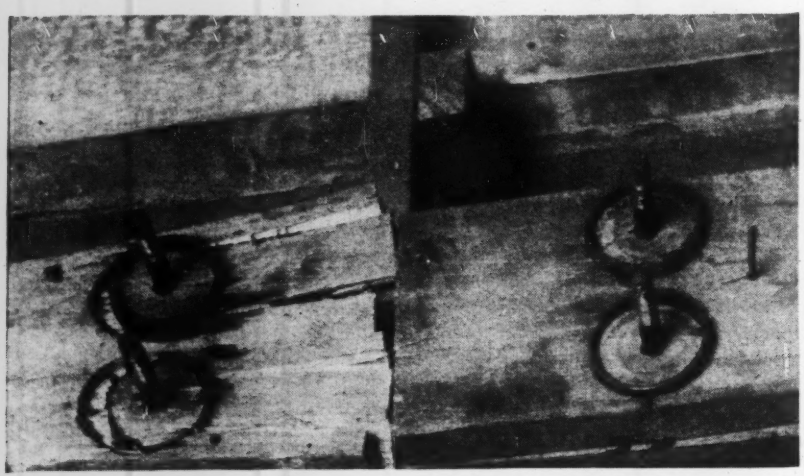


Fig. 1. Failure in tension splice under dead load of some months' duration (outside splice plate removed).

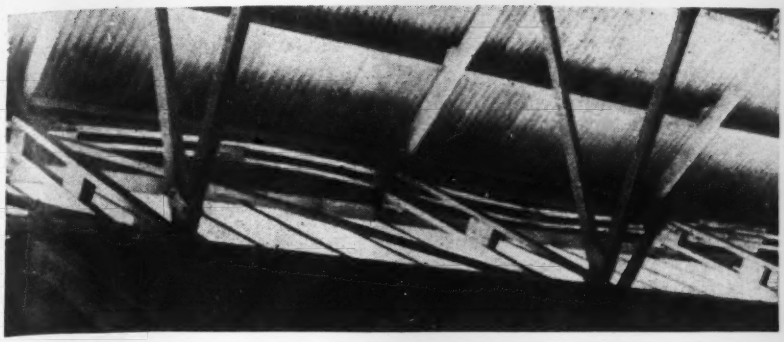


Fig. 3. Failure of top-chord of a 63-ft. span Pratt roof truss under dead load of some weeks duration. Top chord deflection of 3 in., in a 10½ ft. panel length occurred without overloading.

associated with shrinkage stresses. Shrinkage stresses, probably assisted by the wedging action known to exist in such joints, cause the initial end splits and as soon as an end split develops the wedging action of the ring causes it to open.

This has been demonstrated experimentally by testing tension joints with artifically induced end splits under short-time loads. It was found that under such conditions the end-splits opened considerably (Fig. 2) and that the ultimate load was less, by about 25 percent, as compared with matched specimens without end-splits. It will be noted that this reduction is not comparable with the great reduction in strength noted in service.

However it is considered that under comparatively low loads of long duration the end-splits will open due to the increasing deflection of the projecting prongs due to creep, (see Fig. 1), until a stage is reached when the opening is sufficient to permit failure of the joint. If two splits develop, as shown in Fig. 2 of *ENR* of July 27, 1945, vol. p. 111, the failure will be accelerated.

Tension joint research planned

As indicated by Mr. Woodruff this type of failure can only be investigated by long-time tests on joints, but it will be realized that such tests are expensive and time consuming. However the Division of Forest Products of the Australian Council for Scientific and Industrial Research has now obtained the necessary equipment for making long-time tests on connector joints and a systematic series of simultaneous long-time tests on 300 tension joints is about to be started. The results of these tests when available should throw considerable light on the problem. In the meantime, I agree with Mr. Woodruff that it is a wise and simple precaution to use stitch bolts whenever end splits are observed.

The experiment on the effect of duration of loading on the strength of connector joints is merely part of a comprehensive investigation being made by the Division of Forest Products into the phenomenon of creep in timber. For example, another series of tests is being made on the effect of duration of loading on the strength of long columns. It has been found in service that columns, which were capable of carrying loads for some weeks, eventually have failed without any increase in load.

Continuous deflection noted

When first erected the chords of a 63-ft. span Pratt truss showed no appreciable deflection but shortly afterwards lateral deflection was observed which gradually increased until at the time of taking the photograph of Fig. 3, a few weeks after erection, the top chord deflection had reached 3 in. in a panel length of 10½ ft. At no time was the truss subjected to live loads or appreciable wind loads.

Preliminary laboratory tests on small yellow stringbark (*Eucalyptus muelleriana*) columns (1 x ¾ in. cross section, 36 in. long, ¼ in. initial eccentricity, 60 percent moisture content) showed that a load, equal to 66 percent of the short-time ultimate load, caused failure in 6½ days. In another case a dense Douglas fir specimen (2 x 1½ in. cross section, 45 in. long, ½ in. initial eccentricity, 26 percent moisture content) loaded to 80 percent of the short-time ultimate strength failed in 28 hr. At the time of writing a matched specimen loaded to 60 percent of the short-time ultimate strength is still holding after 60 days but the lateral deflection is increasing at a uniform rate.

It will thus be apparent that the effect of duration of loading (creep) although often overlooked, is of considerable importance in the design of timber structures.

Large Highway Receipts In New York State

New York State highway receipts during the decade 1934-1943 aggregated $1,390,745,000, composed of $1,095,358,000 motor fuel tax, registration fees, special carrier imposts, and tolls; $113,940,000 Federal aid; $1,829,000 other Federal contributions; $142,823,000 proceeds sales of bonds; $8,737,000 received for highway use from local government jurisdictions; $13,879,000 earnings of sinking fund; and $14,179,000 miscellaneous income.

Disbursements during the same period aggregated $1,375,071,000 representing $27,510,000 cost of collection and administration of motor vehicle imposts; $334,376,000 construction; $96,449,000 maintenance; $8,358,000 administration, engineering, and equipment; $12,709,000 state highway police; $51,519,000 repayment of borrowed money, and $74,639,000 interest on debt; $235,843,000 expended on local roads or made available to minor jurisdictions for that purpose; and $533,668,000 for non-highway purposes.

High rate of tax diversion

The State of New York is the greatest offender in the diversion of highway user taxes to non-highway purposes, 31 percent of the total of such taxes diverted by all the states which were guilty of that practice during the decade covered having been diverted by that state. The $533,668,000 shown above as so used closely approaches 50 percent of its total highway user imposts.

These figures are calculated from data in the "Highway Facts" studies being issued by the National Highway Users Conference for each State, compiled largely from official tables of the Public Roads Administration. Single copies are available for a number of states at $1.00 each—quantities of ten or more, 75c. each.

Construction Practices in South America

Arthur J. Boase

Manager, Structural Bureau, Portland Cement Association

***Editor's Note**—Widespread use of small size concrete members in South American buildings might lead to the conclusion that the quality of concrete and the methods of construction are superior to those employed in the U. S. In this article, fourth in a series on South American building practices, Mr. Boase says this is not the case—aggregates and mixes are only fair and methods used for placing the concrete are far from perfect. He then outlines his observations on a number of construction operations that were visited in the course of a special editorial assignment for Engineering News-Record. Previous articles by Mr. Bease appeared in the issues of Oct. 19, 1944, vol. p. 499; April 19, 1945, vol. p. 564; and June 28, 1945, vol. p. 902.*

IT SEEMS TO BE very difficult for the structural designers of the United States to understand why it is possible for South American engineers to design and construct buildings whose structural members are so much smaller than we are accustomed to in this country. After I have talked to a group of engineers interested in this field I am always confronted with two questions: What about the climate? Aren't their construction methods superior to ours?

Certainly the climate in the sections visited is mild, but that does not mean that there is no freezing and thawing; there is a great deal of rainfall and likewise much dry weather. On this trip I was principally interested in building construction and since a very major portion of this work was unexposed, as it is in this country, I do not believe that the difference in size of members can be attributed to differences in climate.

One of the great defects of reinforced concrete in this country is the breaking out of bars on exposed work, and surely no one would suggest a coverage of only 0.4 in. (1 cm.) in the climate of a goodly portion of the United States. If the coverage specified in our building regulations were limited to exposed work, the size of only a small percentage of the members in most jobs could be explained as affected by climate.

The question about methods of construction is, I am certain, provoked by mention of higher unit stresses used in these southern countries and the assumption by us that no one would use higher working

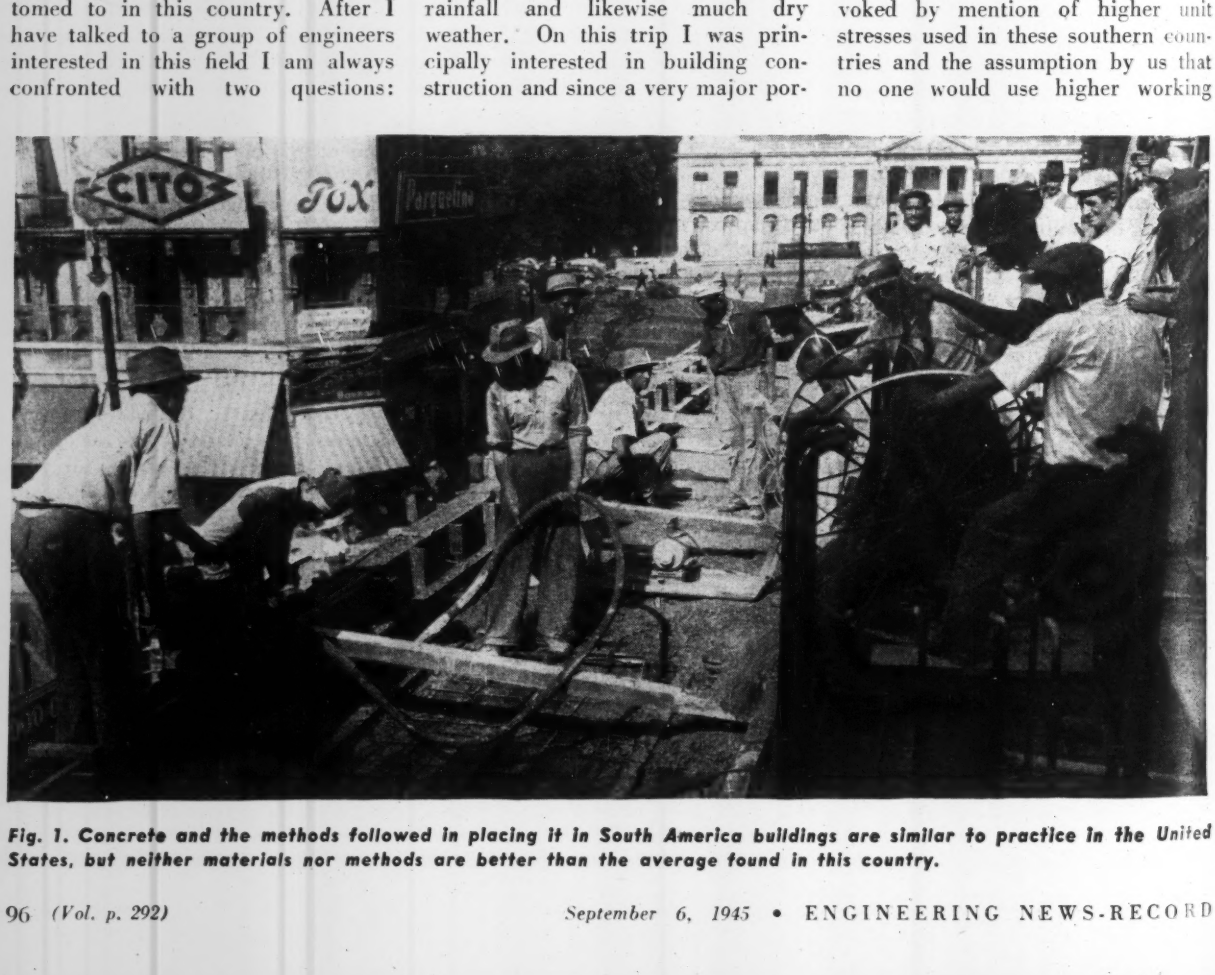


Fig. 1. Concrete and the methods followed in placing it in South America buildings are similar to practice in the United States, but neither materials nor methods are better than the average found in this country.

resses than we do unless the con-ruction were superior to that which see in this country. One would intrepid indeed to be too positive giving an answer to this question ter a three months' inspection trip hich, at best, afforded an oppor-nity of viewing only a fraction of of the great amount of work that under way in the three countries covered in this relatively short pace of time.

Some excellent construction

I saw some very excellent rein-orced concrete construction. An mmense new grain elevator and the anco de La Nacion at Buenos Aires, rgentina, and the steel mill at Volta edonda, Brazil, were conspicuously plendid jobs. I also saw some work hich I would regard as perfect illus-rations of "how not to do it". I hall long remember one job, which was asked to leave when the super-ntendent learned that I was a foreign ngineer. The concrete as it came rom the mixer was watery and ggregated badly. The forms were oorly made. The reinforcing steel as so badly placed and anchored hat it fairly bounced as the concrete ell from the buggy to the form. etween these two extremes one ould observe all the gradations of orkmanship conceivable. If I were o express an opinion based on the obs I visited I would say that con-truction practice in the United tates is most certainly not inferior o that in South America, and it hould be remembered that I was uch more interested in seeing good obs than I was in visiting poor or verage jobs.

American contractor has no peer

Too often we believe that better ork is done far away. Before visit-ng Germany I had been led to elieve that I would find the world's inest concrete the minute I set foot n that country. Germans living here onvinced me of that, but I know ow it isn't true, and the more coun-ries I visit the more convinced I become that the United States con-tractor can compete with those from ny country on any fair basis of comparison. Certainly when it comes to speed of erection he has o peer. In France I was greatly amused by contractors confronting me with American technical litera-

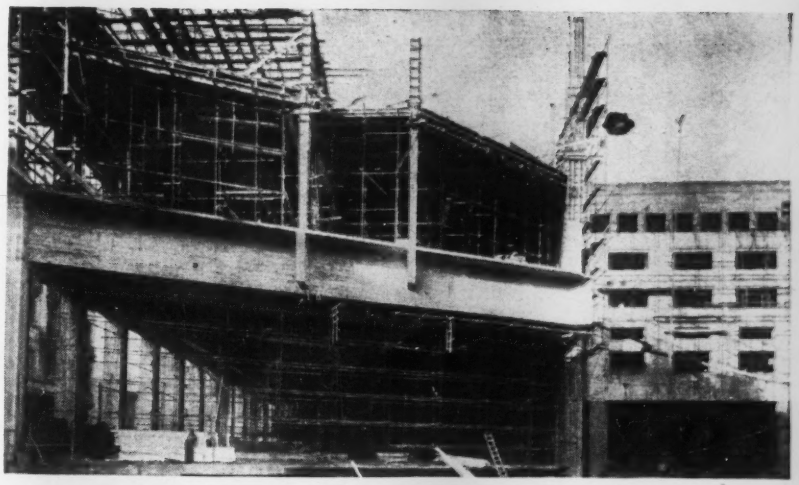


Fig. 2. Banco de La Nacion, Buenos Aires. Arienti & Maisterra, structural designers and contractors: Alfredo G. Acha, chief engineer. Note pipe centering and scaffolding. Long span concrete girder is reinforced with 52 tons of reinforcing steel. An excellent concrete job.

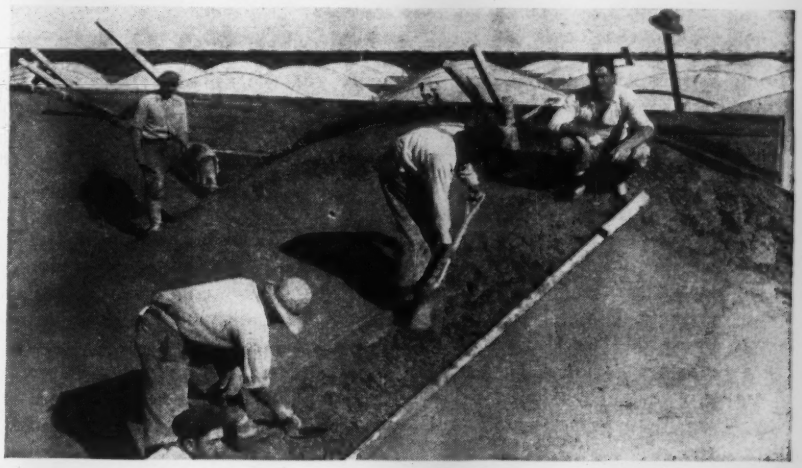


Fig. 3. Placing 2 in. of 1:8 pumice concrete as insulation on thin shell structure near Buenos Aires. Shoring used on this job was bamboo poles 20 to 30 ft. high. Designed and constructed by Carlos Forn of Buenos Aires.

ture in which the time consumed in the erection of a given structure was stated. Always the French contractors would ask, "Isn't that statement a mistake?". They simply could not believe that our contractors could accomplish such great feats in such short periods. Distant fields are not always greener. They just look that way.

The concrete used in South America does not attain the strength that United States engineers have become accustomed to. In going from job to job I got the impression that for a given water-cement ratio the strengths being obtained were about 60 percent as great as are common in the United States. Since returning to this country I have had an opportunity to check the above figure. In "Calculo de Concreto Armado", by Telemaco van Langendonck, published in Sao Paulo, Brazil, in 1944, are shown water-cement ratio curves on which I plotted American laboratory data and found the 60 percent figure to be approximately right. This is verified, too, by the Brazilian code, which requires a minimum cement content of 5.4 bags per cubic yard of concrete and a minimum strength of 1,620 psi. in 28 days.

The aggregates being used in the visited countries are river sand and gravel, river sand and crushed rock (usually a good grade of gneiss),

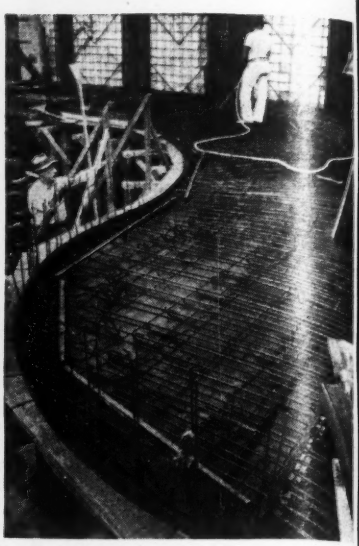


Fig. 4. Placing steel for floor system in Edificio Azevedo Villares. "Hickies" in foreground are typical of those used for hand bending of reinforcing steel. At right, steel in position for balcony above first floor. The building was designed, constructed and owned by Severe & Villares of Sao Paulo. This firm has completed about 2,700 structures.

or made sand and crushed rock. Around Buenos Aires pumice is quite plentiful and cheap. It is often used in making concrete for fill or as insulation as shown in Fig. 3. At Montevideo a disintegrated granite is often mixed with the crushed rock because it is less expensive and produces a more workable mix. It could not be classed as a sound aggregate in our northern climate, but where used in unexposed work it seems to give satisfactory results. Generally, the majority of the work visited was being done with river sand and crushed rock.

The quality of the sand and its grading vary greatly. Some sand is quite good, but in places it carries quantities of organic matter, especially roots of plants. Where this occurs I was told it was customary to screen the sand, but I failed to find any screening being done. While I did not see many sieve analyses, I felt that the sand was on the fine side.

The locally made reinforcing steel is all plain round rods of two grades, one about the equivalent of our structural grade, and the other near our intermediate grade. The South American engineers prefer the structural type and it is used on a great majority of the jobs. The only deformed steel that I saw came from the U. S. and was intermediate grade. This is a small percentage of the reinforcing steel used.

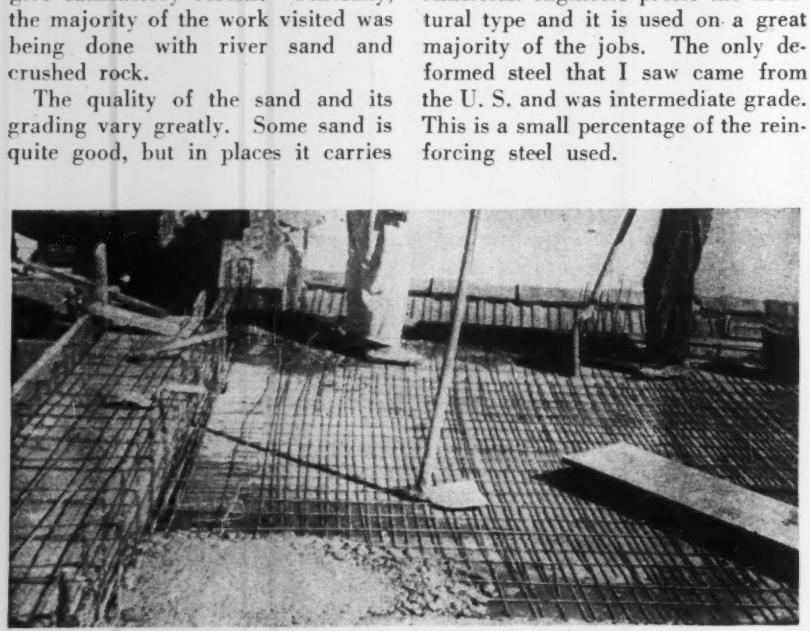


Fig. 5. A more typical reinforced concrete job. This slab is 2.8 in. thick. Rods 3/16 in. dia. laid on forms will be "hooked" to raise to position.

In general, the bars used are small, following the European practice. However, bars up to 2-in. dia. are carried in stock and these large sizes are frequently seen on work. All bars come to the job in one single length; most of them are bent in the shape of a hairpin as a convenience in trucking through the streets.

All fabrication is done on the job mostly by hand labor. I made inquiry as to the use of power benders but failed to locate any. Benches are equipped with slots for pins and these can be moved to produce the desired shape. Bending is done by wrenches equipped with long pipe handles (Fig. 4), as many as four men jerking and straining to bend 2-in. bars to form hooks or other small radius bends. When you watch this operation for a while you do not need to be told that labor is cheap. Nevertheless, they produce some neatly fabricated reinforcing, well within accepted construction tolerances.

Accessories, such as bar supports, that in this country come to the job fabricated, are not generally used. Usually they are made on the job and consist of short pieces of straight bars or bars bent in such a way as to support the main steel as shown in Fig. 4. In many cases supports are not used at all. The bars are merely placed on the deck or in the forms, and after the concrete is placed workmen with hooked rods attempt to

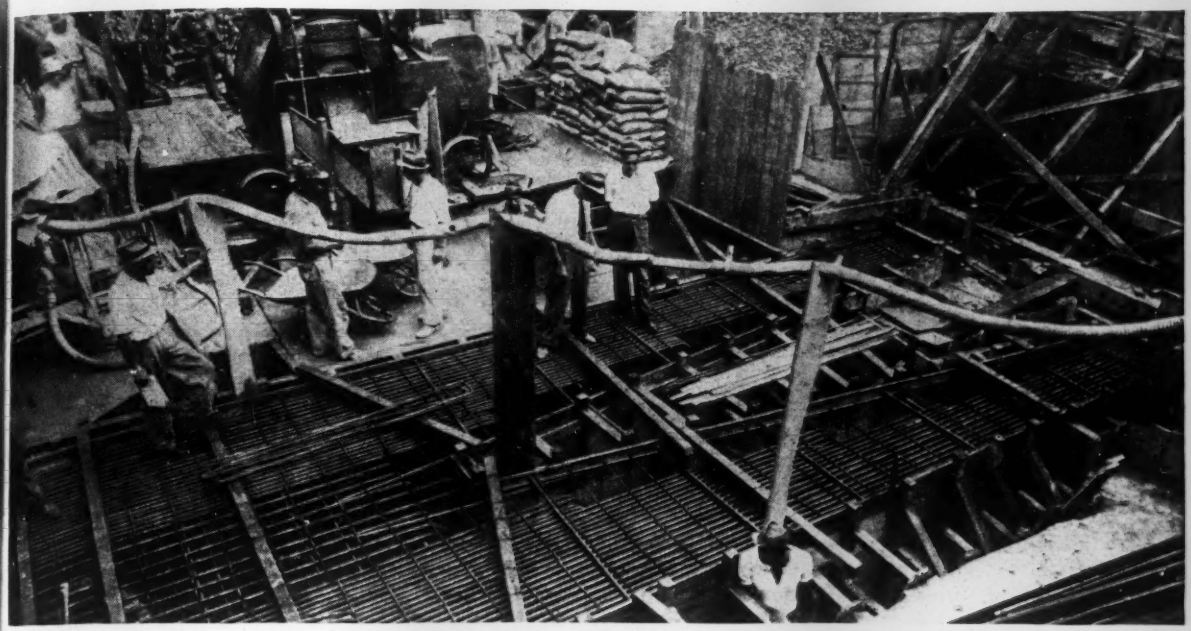


Fig. 6. Steel set and forms ready for concrete in a cantilevered footing for building in Sao Paulo, Brazil. Note plain bars and excellent setting.

pull the reinforcing into place, as shown in Fig. 5.

When you consider that slabs, where this practice is followed, may be as thin as 2.8 in. and that the calculations have been made assuming a cover of only 0.4 in., you hope that the rods are pulled up enough, but not too much! Actually, I saw jobs being stripped where it seemed that most of the bars were exposed. Workmen, with brushes and buckets of mortar, were put to work splatter dashing to cover the rods and produce a surface to receive the plaster or other finish.

The job shown in Fig. 6 is a cantilevered footing, and the steel, 1-in. round plain bars, is certainly well placed and tied together in a substantial manner. If any bars are spliced it is done by threading the bars and joining by means of pipe sleeves. The code permits lapping of bars, welding, or the use of sleeves, but it is quite general practice for bars over 7/8 in. in diameter to be spliced by threaded sleeves.

Forms exclusively of wood

Form lumber in the three countries visited is obtained principally from two states in southern Brazil, Parana and Santa Catarina, and is of a type of pine not unlike our own southern pine in appearance. Material I saw on jobs usually was boards 1x4, 1x6, 1x12 or dimension timber 3x3 in., 3x4 in. or 3x12 in.

The form lumber seemed rougher and not so well dressed as our own material, and after the forms have been stripped this gives an impression that concrete placing has been cruder. This, of course, is not necessarily true and, inasmuch as most of this concrete is to be covered up later, is of no consequence. It seemed to me, too, that there were more and larger fins than I am accustomed to.

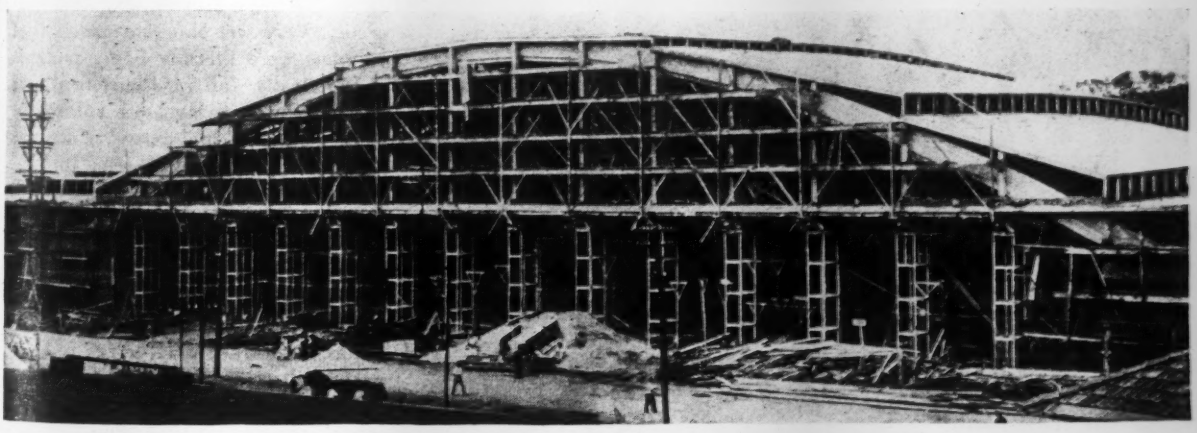


Fig. 7. Hangar in Rio de Janeiro. The lower centering is cast-in-place concrete. Designed by Servicos De Enginharia Emilio Baumgart Ltda.

All sizable jobs are equipped with circular power saws, and beam sides and bottoms, panels (if used) and column forms are made up at the bench. I did not see any metal column clamps, entirely understandable considering the price of steel. In their place wood is employed and the use of wire and wedges is quite common.

Form ties usually consist of wire or small rods (3/16 in. in diameter) used in connection with spreader blocks. I saw no use being made of specially designed steel ties such as we use, but I understand they are sometimes employed.

In general, the workmanship seemed fairly good but it was not superior to that observed on U.S. jobs, and the South American general practices as to building, erection and stripping of forms are not greatly different from our own.

Usually the forms are sprinkled just before placing of concrete begins; sometimes a soap solution is used, less frequently, oil.

Centering to support slabs and beams is usually 3x3 or 3x4 timbers and is adjusted by means of wooden wedges. I saw no adjustable shores. In a few instances, as in Fig. 2, pipe centering is used, and in other cases cast in place concrete is utilized as shown in Fig. 7. Near Buenos Aires bamboo is relatively cheap, and was used as centering for the thin shell roof shown in Fig. 3.

SUPPORT REQUIREMENTS FOR FRESH CONCRETE

Brazilian code stipulations for length of time forms and supports must be retained.

	Normal Portland Cement	High-early Strength Portland Cement
Walls, columns and sides of beams....	3 days	2 days
Slabs up to 4-in. thickness	7 "	3 "
Slabs of more than 4-in. thickness and soffits of beams up to 32-ft. span....	21 "	7 "
Arches and soffits of beams of more than 32-ft. span	28 "	10 "

At the steel mill being constructed at Volta Redonda, Brazil, a plant designed for an initial capacity of 1,000 tons of steel per day, a most ingenious type of moving form, made of concrete, was employed in the erection of the rolling mill shed (Fig. 9 and 10). Entirely new to construction in this country, the concrete form support was designed by Prof. Antonio de Noronha of Rio de Janeiro and consists of a double web T-beam of 93-ft. span with a flange wide enough to carry the falsework for the rigid frame concrete gabled roof.

The concrete beams are so designed that under their own weight the tension rods are not expected to take load and only come into play as a truss when carrying the superimposed load. The ends of the forms rest on trucks with flanged wheels, which travel on the rails that later will carry overhead cranes when rolling of steel starts.

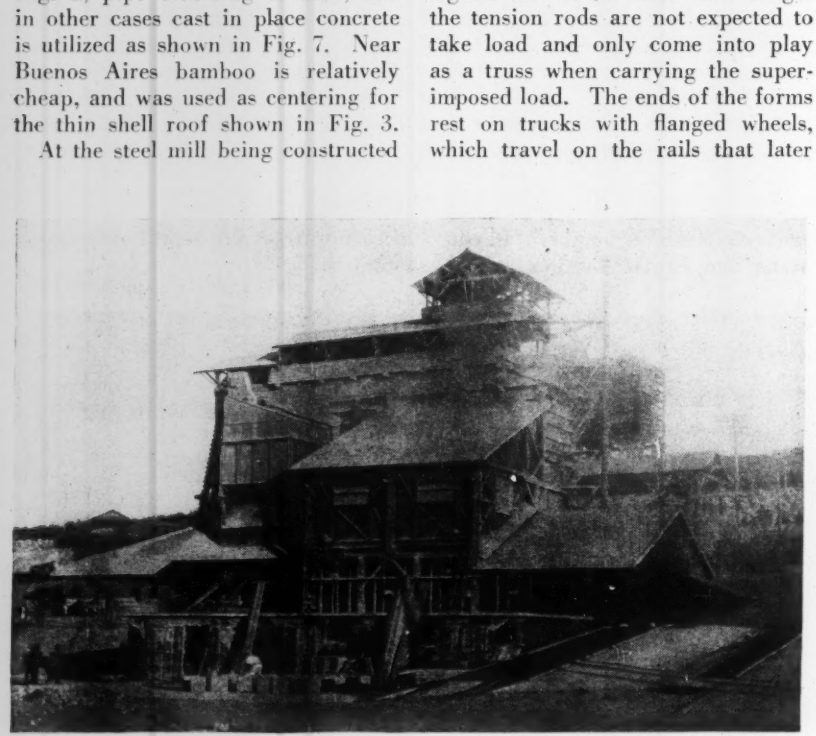


Fig. 8. Rock crusher, central batching plant and control laboratory at Volta Redonda. This is the only central batching plant in Brazil.

Familiar 1:2:4 mix

In general, the concrete mixes used in South America are of arbitrary proportions, and 1:2:4 is a common answer to the query, "What mix is being used?". It is true that in the large population centers there are technicians and laboratories thoroughly competent and well equipped to accurately proportion the ingredients to give a better balanced mix. I visited the Instituto Nacional de Technologica at Rio de Janeiro and the Institute de Pesquisas Technologicas at Sao Paulo where this work is being well done for many important jobs. Facilities for the same purpose are available in Buenos Aires and Montevideo, as well as in other important cities. Nevertheless, educating both supervisors and users is just as difficult there as here. While progress is being made, they have some distance to go before scientifically proportioned concrete becomes the rule rather than the exception.

The same might be said regarding the use of water. The quantity used seems to be very much left to the judgment of the mixer operator or the foreman of the concreting gang. I visited one rather important building operation with the contractor while the concreting work was going on. When we arrived at the mixer and observed the rather wet concrete being discharged he remarked, "We are pouring columns today". I asked him how he knew, and his reply was that he could always tell what part of the job was being concreted by the consistency of the concrete. Very wet concrete meant that columns were literally being poured.

Practically all measurement of aggregate is done by loose volume in wooden measuring boxes, and the general scheme can be seen in Fig. 6, the wooden box to the right of the mixer, with long handles on either side, being about standard equipment in use.

In Brazil a bag of cement weighs 94 lb., the same as in the United States. All other weights are in kilograms. It reminds me of many years ago, when working in Mexico, we would tell the native workmen to dig a ditch a meter wide and a foot deep. In other South American countries a

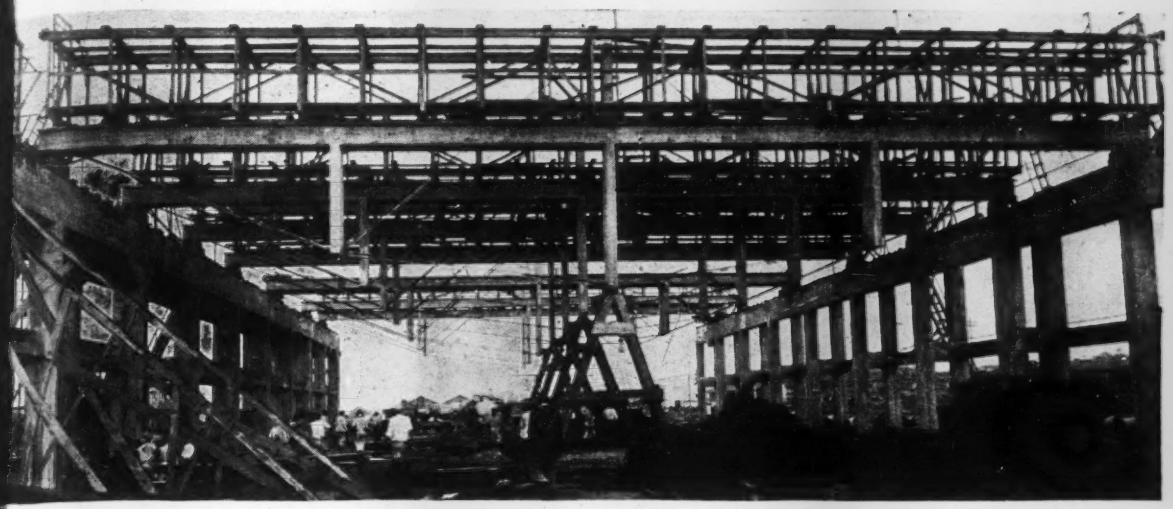


Fig. 9. Traveling form-support of reinforced concrete in the shape of an inverted truss as used on construction of the rolling mill of steel plant at Volta Redonda, Brazil. Paulo O. J. Brito, engineer.

bag contains 50 kilograms or 110 lb.

Modern plant at Volta Redonda

There is not a single ready-mix plant in Brazil, and while I did not visit them I was advised that the other countries do have ready-mix plants in operation. The only central batching plant in Brazil is shown in Fig. 8. This is located at Volta Redonda and was set up to supply some 400,000 cubic meters of concrete required to erect the steel mill now under construction at that place. The plant has a capacity of 1,100 cubic meters of concrete per day.

Stone for this job is quarried nearby and is brought to crushers located at the batching plant. The stone (gneiss), of about 1-ft. size, goes through two primary crushers and through a series of four other crushers, where it is reduced to 2-in. top size. It is then elevated in buckets on a belt, passed over screens and separated into 2-in. and 1-in. sizes.

Most of the fine aggregate used is a natural sand, but some of it comes from the stone screenings. Particles in the screenings of sizes not wanted for the making of ordinary concrete are separated and used in the manufacture of concrete block. The block is needed for houses for 10,000 people as well as for filler walls for main plant buildings. These blocks are made by hand operated machines.

The sand and two sizes of stone are stored in bins over the batcher and then weighed, on U.S.-made scales, into U.S.-built truck-mounted mixers.

In all there are twelve 2-cu. yd. capacity trucks, two 1-cu. yd. pavers, and several 1/2-cu. yd. mixers used in this operation.

A first class laboratory is maintained near the batcher plant, where there are constant temperature and constant moisture rooms. The moisture in the sand is determined five times daily. Sieve analyses are made at regular intervals and, if necessary, proportions are changed accordingly. Routine tests, such as specific gravity, silt and clay deter-

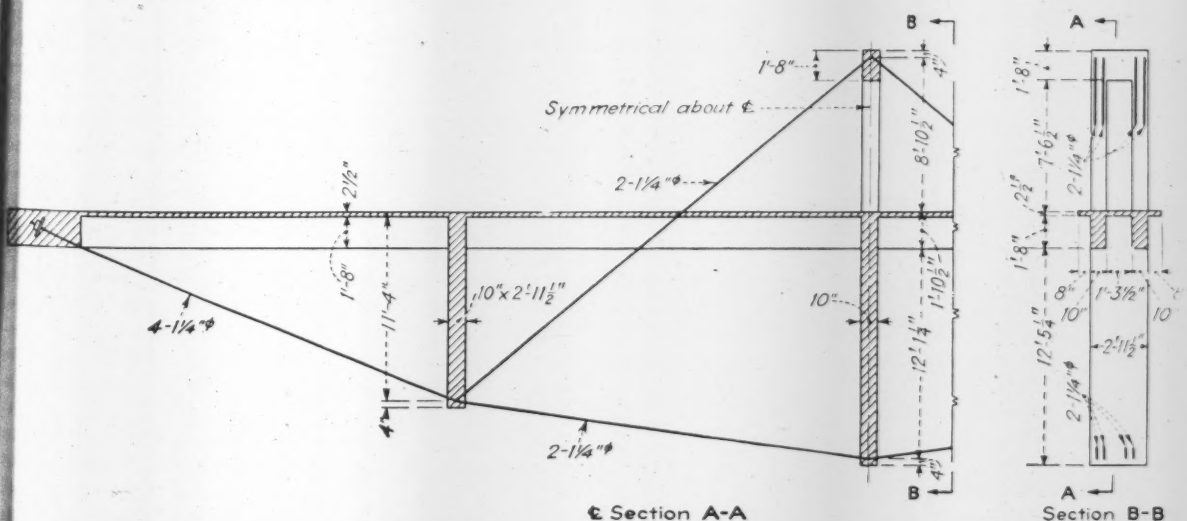


Fig. 10. Rods used as the tension members of the moving form support at Volta Redonda are cast into the concrete.

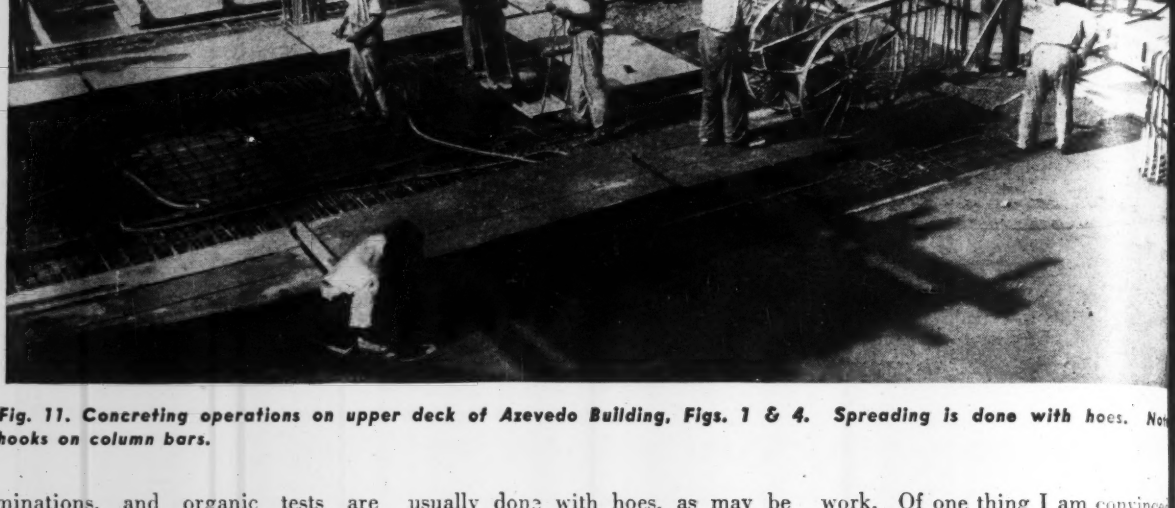


Fig. 11. Concreting operations on upper deck of Azevedo Building, Figs. 1 & 4. Spreading is done with hoes. Not hooks on column bars.

minations, and organic tests are made at regular intervals. Two bags of cement are tested from each carload received, and four cylinders are made from each 15 cubic meters of concrete. Cylinders are broken at 7, 28 and 90 days.

This was by all odds the best controlled job visited, and the concrete going into the forms was as uniform as any I have seen. Further, the finished work was excellent. Ever present were the air holes on the finished concrete surfaces, and the longer I work with concrete the more suspicious I become of concrete without them.

The mixers seen on jobs, Fig. 6, are of a wide variety, some coming from the United States, England and Germany, and some are made locally, but all are of comparatively small capacity, usually not over 1/2-cu. yd. Some are equipped with water gages and timers, but it seemed to me that the operator had a great deal to say about the use of both.

Usually concrete is elevated to upper floors by means of a central tower built of wood. The mixer is slightly elevated and on the edge of a pit, permitting chuting into a steel skip that can be hoisted for dumping into buggies at desired elevations. The concrete is then conveyed to place of deposit in steel buggies on wooden runways. The buggies are imported from the U.S. or made locally, and may be either steel or rubber tired.

Spreading of the concrete is usually done with hoes, as may be seen in Fig. 11. Compacting of concrete is accomplished by spading with sticks and sometimes with vibrators. On this job, representing the best practice, both spud and platform vibrators are being used. The vibrators may be imported or made locally. Around large cities the contractors usually prefer electrically driven equipment. Gasoline is expensive and hard to obtain, especially at the present time.

Antiquated chutes still in use

I was somewhat surprised to note the number of jointed steel chutes in use on some jobs. The concrete is lifted to high elevations, permitting the chutes to swing over a very large area. The chutes are of the type that were used in this country many years ago but which fell into disfavor, for obvious reasons.

The curing of concrete on building operations is, as in this country, accomplished largely by leaving the forms in place. While the codes call for keeping the concrete wet for a period of about seven days I question whether this is done in any systematic or adequate manner.

Inspection of work while in progress is not superior to what we know in this country. On some jobs inspection is very good; on others it is very limited.

In all of the above I have for the most part written of the best practices. There is not much point in mentioning mediocre or inferior work. Of one thing I am convinced and that is that there is nothing in South American construction practice which justifies their use of higher working stresses and the use of more slender members.

It is admitted that the time consumed to accomplish a given amount of work in South America is much greater than we are used to. We have been accused of rushing jobs to the point of becoming careless. No doubt we do build with great speed. We use all of the machine help possible. We save on labor whenever possible. That does not mean we are more careless with our work or that we produce an inferior product.

The accomplishment for war should have convinced designers that the U.S. contractor has great capacity for quick production and that he can accomplish anything that any other contractor is capable of. When there is a closer relationship between designer, specification writer and inspector, confidence in the product will follow. Too often in this country the designer or specification writer never sees the work under construction nor has he necessarily had large construction experience and this tends toward caution, possibly overcaution. That is where the particular client-contractor relationship so common in France, Germany, Italy and South America has its advantages. The entire effort being within one organization, all are advised of the others' problems and cooperate sympathetically.

Multiple Grouting of a Dam Foundation

L. F. Harza
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***Editor's Note:**—On the Rincon del Bonete Dam in Uruguay, completed under Mr. Harza's supervision, drilling and grouting of the foundation was done in 13 ft. increments. The holes were redrilled to the same depth and again grouted successively until they would no longer take grout, after which the holes were extended another 13 ft. and the process repeated. Records show that as much grout was used on the successive regroutings as on the original application. The author compares this "step-grouting" procedure with the conventional process and presents a possible explanation of the unusual results that were obtained.*

GROUTING in successive steps, redrilling the same holes and again grouting was the procedure used to assure safe foundations for the Rincon del Bonete dam and hydro-electric project on the Rio Negro in central Uruguay. The dam is about 140 ft. high and will create an ultimate effective head of 105 ft. The total length is 3,846 ft., about 3,500 ft. of concrete, and the remainder of earth with concrete core. This project was started by a German syndicate, was interrupted by the war, and is now being finished by United States engineers and equipment manufacturers. (*ENR* May 31, 1945, vol. p. 721).

The dam is founded upon a basaltic lava of varying degrees of soundness. The foundation under the highest portion, across the river bed, where the foundation loading would normally be the greatest, is of the poorest quality. This led to the adoption, for this portion, of a hollow dam of round-head buttress, or Noetzli type, including the powerhouse intake, the spillway and a bulkhead section of total length of 1,270 ft.

The powerhouse intake and five gateways of the spillway were enclosed in the first cofferdam and the remainder in the second cofferdam. Experience in grouting the cut-off in the first stage led to the adoption of multiple grouting of the cut-off of the second stage.

The procedure in the first cofferdam was to drill and grout in steps of four meters, or about 13 ft. each. The hole was first drilled 13 ft. below the concrete cut-off through pipes left in the concrete for that purpose. After grouting this step and waiting for the grout to stiffen enough not to surge back into the hole, the hole was then re-drilled to initial depth and deepened 13 ft. more, and grouted below a rubber "packer" placed at the 13-ft. depth. Thus progressively the hole was drilled and grouted to a total depth of about 80 ft. in six steps of about 13 ft. each.

Same hole regrouted

It was discovered that not only the newly drilled 13 ft., but the previously grouted depth of hole accepted grout on some occasions, and for the second cofferdam the technique was changed to "multiple grouting" of each 13-ft. step to refusal before deepening the hole. This does not appear to be an entirely new technique in the United States having been used recently by the Tennessee Valley Authority at Hales Bar Dam and to some extent elsewhere. But the results obtained in Uruguay are so striking as to deserve presentation.

TABLE I. GROUTING PRESSURES AT VARYING DEPTHS

Step	Elevation	Pressures Atmospheres	Lb. per sq. in.
1	134.5 to 147.6	7	98
2	121.4 to 134.5	11	154
3	108.3 to 121.4	15	210
4	95.1 to 108.3	20	280
5	82.0 to 95.1	20	280
6	68.9 to 82.0	20	280

After first grouting of the first step of 13 ft. below the concrete cut-off, an interval of 8 or 10 hr. was permitted to elapse, to allow the grout in the rock to set sufficiently so that it would not return to the hole, and the hole was then re-drilled through the cement to former depth and size. Grouting was then repeated until the limiting pressure was again reached, and the cycle repeated by again re-drilling and re-grouting until negligible additional grout could be injected.

After thus completing the first step, the hole was drilled 13 ft. deeper into the rock for the second step, and the process repeated with the packer located just above the bottom of the first step. If cement were to return to the hole above the packer at any time, the packer was raised until pressure could be built up without such return. The grouting steps are numbered downward from the bottom of the concrete cut-off at El. 45 m. or 145 ft. and the pressures used were as shown in Table I.

It is surprising to learn that the first grouting of a given step seldom if ever completed the grouting of that step. "Re-grout" or additional grout injected after the first grouting was often far more than the initial grout and sometimes many times greater. Table II shows selected examples of both extremes encountered in grouting.

"Ratio of Re-grout" refers to total grout *after* the initial injection in proportion to the initial injection. It will be noted from the table that L-133-6th step, L-137-5th step and L-161-2nd step were practically completed in one grouting, but that the re-grout ratio in other steps ranged from 1.07 to 20.8.

Table III is a partial compilation of results of multiple grouting as applied to each hole as a whole instead of the individual steps thereof as in Table II. In column 5 of Table III it will be seen that the average "re-

grout" of these 13 holes is 0.957 of the first grouting.

Obviously the re-grout ratio of an entire hole, being an average of all six steps, is lower than the re-grout ratio of some individual steps. But the above ratio indicates that this group of holes were only approximately *one-half grouted* the first time.

It is necessary to find a plausible explanation of this surprising record. Observations during grouting excluded the possibility of lifting the rock strata as an explanation of the large volume of re-grout. Shrinkage of initial grout could only account for a small percentage. It is not the result of increasing pressure, since each successive grouting of the same step was concluded at the same pressure. The following theory would seem to be plausible.

A plausible reason

On the first grouting of any given step, the grout would of course follow the path of least resistance requiring little pressure, if any, until it would eventually fill up some cavity or group of cavities most easily reached from the grout hole, in the meantime perhaps escaping from only a small portion of the inside surface of the hole. As this might require many hours or even several days, the cement would coat the remainder of the inside surface of the hole and harden, thus sealing the surface of the hole except where initial and continuous flow kept it open. The result would be the grouting only of the cavity or cavities which freely communicated with the path of least resistance from the hole.

By re-drilling or reaming the hole after initial set of the first batch of grout, paths of communication would apparently be opened up to other cavities that did not receive grout in the first instance because the communicating path offered greater resistance at first, and would be sealed off by hardened grout when the pressure did become high enough to grout them. Thus, in theory, by several repetitions the various communicating cavities would be filled up in the order of the resistance of their paths of communication with the grout hole.

Multiple grouting of each step accomplishes a purpose similar to step grouting except to carry the idea to it ultimate limit. Thus step grouting, even if only once per step, tends to prevent exclusion of grout from the cavities communicating with one part of a hole by hardening of the cement at their approaches, while cement is flowing into some path of less resistance elsewhere along the hole. Likewise multiple grouting of a given step serves the same purpose to a greater degree.

Step grouting has been used to some extent in the United States and multiple grouting at Hales Bar Dam and perhaps elsewhere. But the more usual American practice, except in difficult recent work, is to grout at one time the full depth of each hole to refusal at a maximum pressure. The spaces between the given hole and nearest adjacent holes would then be bisected by a new hole likewise grouted and the process repeated until new holes would refuse grout. This program might require more holes to be drilled but is a simpler procedure. It does not permit the use of different grouting pressures at different depths in the hole.

Slow rate of grouting

The question arises whether this deficiency or incomplete initial grouting status in Uruguay is typical of once grouted holes in general, or whether there were special circumstances to account for this low result. There is only one condition of grouting at Rincon del Bonete which might perhaps have a bearing upon the large re-grout ratio. This is the slow

TABLE II. GROUT TAKEN BY SELECTED 4 M. (13 FT.) LENGTHS OF HOLES AFTER REDRILLING

(Figures are in cubic feet of cement per injection)

Hole L-133.	1st Step	3rd Step	6th Step
1st grouting	12.15	15.41	46.42
2nd grouting	8.35	41.10	.87
3rd grouting	4.70	2.49	
Ratio of re-grout	1.07	2.83	0.019
Hole L-135.	1st Step	2nd Step	
1st grouting	7.48	1.31	
2nd grouting	9.25	27.00	
3rd grouting	2.80	0.28	
4th grouting	0.73		
Ratio of re-grout	1.81	20.8	
Hole L-137.	3rd Step	5th Step	
1st grouting	12.05	47.55	
2nd grouting	23.46	2.79	
3rd grouting	41.10		
4th grouting	18.79		
5th grouting	0.19		
Ratio of re-grout	7.0	0.059	
Hole L-161.	2nd Step	3rd Step	4th Step
1st grouting	31.82	6.84	6.74
2nd grouting	0.87	24.62	35.98
3rd grouting		28.02	48.18
4th grouting		32.00	0.59
5th grouting		0.09	
Ratio of re-grout	.027	12.4	12.7

TABLE III. COMPARISON OF GROUT USED INITIALLY AND ON RE-GROUTING FOR FULL DEPTH OF THE HOLE

Hole	Depth ft.	Initial grout cu. ft. cement	Re-grout cu. ft.	Ratio of re-grout	Cu. ft. cement per lin. ft.
L-143	86.0	918.0	325.0	.35	14.49
L-141	85.4	107.8	916.0	8.49	12.00
L-139	92.0	885.0	368.2	.42	13.61
L-137	78.8	436.5	346.1	.79	19.93
L-135	65.6	61.0	199.4	3.27	3.97
L-133	78.8	324.5	242.2	.75	7.20
L-131	80.5	262.0	33.4	.13	3.67
L-129	85.7	337.0	114.4	.34	5.28
L-127	78.8	88.0	11.5	.13	1.26
L-125	78.8	445.4	120.9	.23	7.20
L-123	73.9	190.0	61.8	.33	3.40
L-121	80.5	49.3	10.0	.20	.74
L-119	73.9	229.4	2.9	.013	3.15
			Average	0.957	

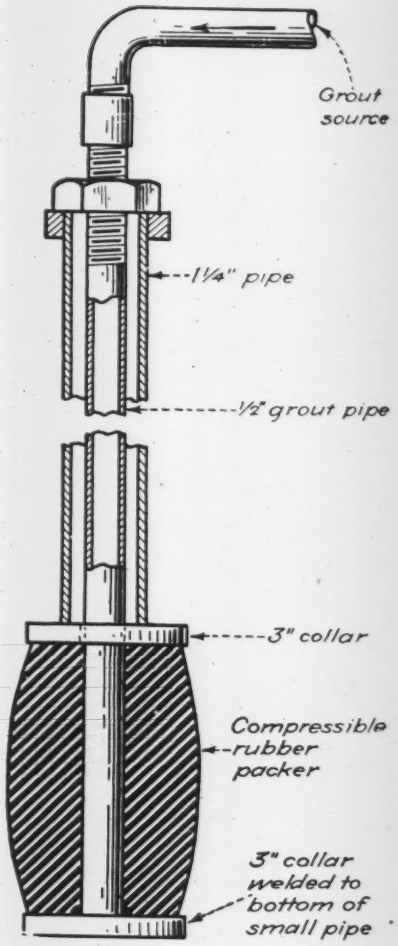
rate of grouting which in turn is related to the equipment used and the procedure employed in the work, more accurately described as follows:

A hole (about 3 in. dia. made with a $2\frac{5}{8}$ in. calyx shot drill) was drilled (1st step) 13 ft. in depth down to El. 134.8 and the grouting apparatus illustrated was inserted. The packer for the 1st step was about El. 148.2, actually in the concrete just above the bottom of the cut-off wall.

The hole was first tested for rate of leakage of water and if the leakage did not exceed 4 liters per minute or one liter per linear meter of hole under the pressure of the 7-11-15-20 atmospheres respectively applicable to the step, no grouting was done in this step at this time because the pump could not run so slowly and cement would segregate from the water and harden in hose and pipe.

In cases where the water test produced a leakage less than one liter per lineal meter at the applicable pressure, the depth of step was increased until the leakage became sufficient for successful grouting or until the hole reached the sound rock at El. 21m. Grouting was done by a displacement pump of Swedish manufacture and of nearly constant speed. Grouting was continued until the limiting pressure was reached for that elevation or step.

On this work the rate of grouting at any stage was limited to the capacity of a $\frac{1}{2}$ in. pipe. This slow rate of injection could have encouraged the setting of the cement in other grout outlets from the hole, while grout was flowing out the initial paths of least resistance. Rapid grouting at high capacity might thus partially have reduced the total amount of re-grout.



Device used to confine grout in step-grouting of Rincon del Bonete project.

It is not easy to visualize just what takes place along the surface of a hole to effectively seal off grout outlets against the first application of pressure and yet so ineffectively seal them that a re-drilling of the hole to the same size would re-open them. It must be assumed that the seal is hardly more than a coating or crust on the inside surface of the hole since no effort was made to ream the hole each time to larger diameter. On the other hand, a drill of the shot type, as used, has some small reaming effect, and might have slightly reamed the hole in re-drilling, although it is not conceivable that this effect could be important when drilling recently set and relatively soft grout in a hard rock hole.

Wider use indicated

It would seem that the amazing result of re-grouting in this instance raises an important question as to whether grouting to be adequate should not always be done by step grouting of isolated zones of depth, and multiple grouting of these zones. Grouting at best can never be perfect. There must always be surplus water. If this escapes, there must be residual paths of escape not sealed off, and if it does not escape, the excess water will remain as voids in the rock structure.

The Rincon del Bonete project is under the direction of Luis Giorgi, director-general. Manuel Salles was the engineer in charge of grouting operations.

States Help Cities with Local Planning

State programs of aid to local planning are illustrated by work of the Alabama, Tennessee and Wisconsin state planning commissions.

The most recent local planning program undertaken in Alabama with help of the state planning board is in Mobile, where a technician from the board has been assigned on a full-time basis, and where a district office of the board has been opened.

The district office plan was inaugurated to make state-local planning cooperation easier, and to place state planning board technicians in easily available spots for consultation, according to the American Society of Planning Officials. At present, three district offices are maintained by the state board: at Mobile, Birmingham and Sheffield.

Under the Alabama plan—and the Tennessee plan as well—municipalities contribute financially toward their own planning with state assistance. In Alabama, the state board developed a formula based on population to determine the municipal contribution.

Tennessee's program is similar to the Alabama plan in that the state plan commission maintains two regional offices and is installing a third. Local government units contribute according to their ability toward the development of a local plan with state assistance. In some instances local units are able to pay most of the costs of planning.

Examples of the state-local planning program may be drawn from the Kingsport-Johnson City-Elizabethton-Bristol area in eastern Tennessee, where a variety of planning activities are under way on a continuing basis.

Under the state-aid-to-local-government plan in Wisconsin, the state planning board, when requested by the community, draws up plans, helps draft zoning and other ordinances, and in general supervises planning developments. In this case, however, the state planning board finances its activities completely.

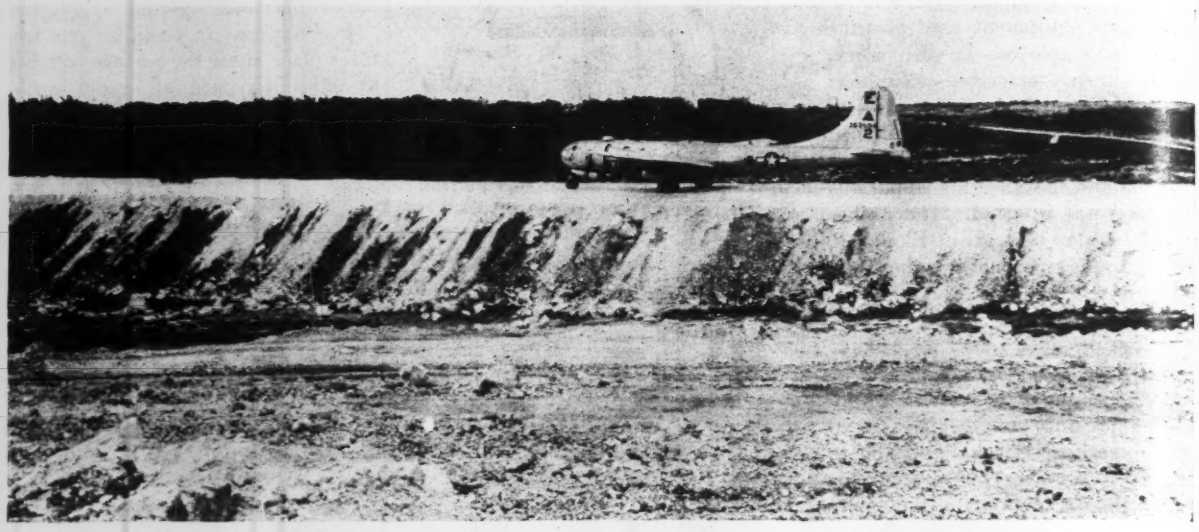


Fig. 1. Under its own power a B-29 moves up a 1½ percent grade on a deep-fill taxiway.

Building B-29 Bases on Tinian Island

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Officer in Charge, Naval Construction Forces, Tinian Island

***Contents in Brief**—The heaviest planes thus far used by the Army Air Force, requiring 8,500-ft. runways, struck Japan from our Tinian Island base where Seabees moved some 10,000,000 cu.yd. of coral to build fields with multiple runways, in some places on fills more than 40 ft. deep. New developments in field methods as well as in administrative control were worked out to fit the unusual character of this project whose enormous size required great concentration of construction forces and equipment. Coordination was so effective that field forces never had to wait for engineering details and all assigned dates for completion were met or bettered.*

ADVANCE PLANNING for airbases on Tinian Island in the Marianas was based on aerial surveys made while the island was still Jap territory. When the preliminary field layout was made it was not known that the program would soon be expanded to include two airdromes each with a number of parallel runways, all 8,500 ft. long and 500 ft. in ultimate width. Nor was it foreseen that sufficient construction forces and equipment would be brought here to permit placement of as much as 88,000 cu. yd. of coral fill per day—or more than a half million cu.yd. in a week.

But from a modest beginning the plans for construction on Tinian Island were speedily (and repeatedly) extended until the result is believed to be the largest base yet built for mass flights of the B-29 Superfortresses.

The major engineering problems on Tinian, however, were not brought about by the size of the operation but rather by complexities of layout and difficulties of handling material. Hard stands and the taxiways to connect them with the airstrips called for the most careful planning. For example, the decision that the big planes would taxi under their own power, instead of following the initial plan of towing by tractor, made it desirable to decrease the taxiway grades from 2½ to 1½ percent. On one field this change increased the coral yardage handled by half a million cu.yd. As another instance, in one of the hard-stand groups the planes are parked on three different levels with difference in elevation amounting to 58 ft. and with one plane almost immediately above another. Yet the interconnecting taxiways between these points and the airstrips do not exceed the 1½-percent grade limitation.

A B-29 base has many additional requirements and more exacting limitations than do ordinary airfields. Under full load these heavy bombers frequently use the entire length of the 8,500-ft. runways, which are required to be 500 ft. wide. Under "minimum operational facilities" the runways may be used in 200-ft. widths; but safety, particularly for the landing of battle-damaged planes, calls for the 500-ft. width. Maximum longitudinal grade is 1 percent but every effort is made to keep the grade the lowest consistent with economical construction.

Hand levels were the only surveying instruments available for several days

after the Seabees began their work on Tinian. Nevertheless, preliminary surveys were made of all available airport sites within a matter of hours after the assault forces had passed through. Crude profiles were drawn on the basis of information obtained from hand levels on jacob-staffs. The locations picked in this manner required only relatively slight modification in final design, these later changes being chiefly to economize on material handling.

Even days later when a few surveying parties arrived, they worked under difficult conditions. Armed guards were necessary for all instrument men because of Jap snipers. For example, Frank J. Chmielewicz, a Seabee rodman who was attacked by a Jap armed with a hand grenade, saved his life by hurling the steel pointed sight rod like a javelin and then pinning down the Jap with it until other Seabees came up. The rodman was on the job again in a few hours after having dressings applied to a large scalp cut.

Fig. 2. Drilling powder holes on the site of an airstrip to parallel completed strip in background. Pusher tractor gives assistance in loading carrying scraper.

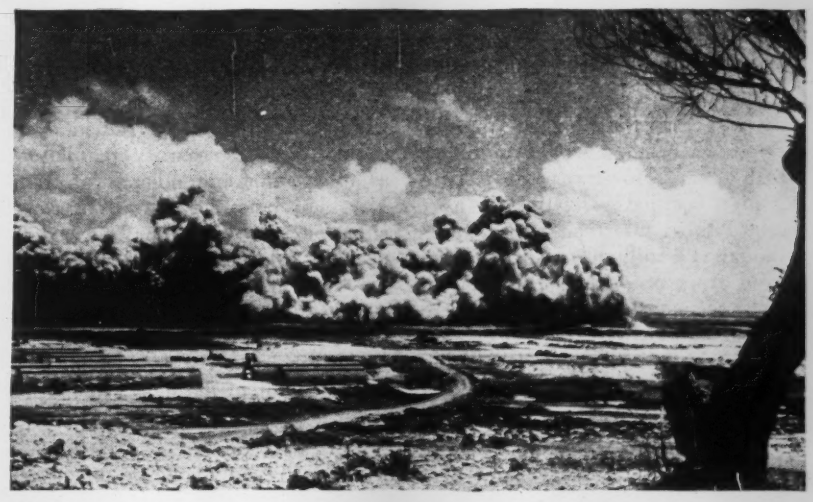

Fig. 3. As much as 56 tons of dynamite was used in a single blast in opening up some of the long pilot cuts.

Coral characteristics

Most of the problems centered around coral, the all important material—where it should be obtained and how it should be handled. Test holes were dug to determine the extent of overburden, characteristics of underlying coral, extent of soil pockets and the location of hard coral heads.

Where the foundation was of the best and had no earth pockets a 6-in. layer of coral surfacing was considered adequate. If there were shallow earth pockets and the subbase consisted of a conglomerate of coral and relatively stable soil, 12 in. of compacted coral surfacing was specified. When the pockets were deep or the terrain required deep fills of relatively stable overburden, not less than 21 in. of carefully compacted coral surfacing was considered adequate for safe distribution of the bomber wheel loads. The 21-in. thickness was reduced to 18 in. if tests to determine the shear value of compacted coral in place demonstrated that the lesser thickness would suffice.

Soil tests to determine the best means of securing the airstrip stability needed for the heavy loads imposed by B-29s were continued throughout the entire construction period and some half dozen field parties were constantly testing with portable equipment. Final preparation of data was made at a central soils laboratory and a complete set of records was maintained on the stability of the substructure and the compacted surface.

Three sources of coral

Part of the work of the soils mechanics detail was the continuous and extensive search for the best sources of coral. Tinian coral is considerably harder and more irregular in structure than that on adjacent islands (Saipan and Guam, for example). Because of the enormous yardages to be handled it was highly desirable to locate pits that could be readily dug with a minimum of blasting. Coral pits were given three classifications:

(1) "Push pits" in which the relatively hard coral may be shaved, so to speak, by a bulldozer blade working down the entire slope to a point where the material could be loaded ("bailed") into trucks with a power shovel.

(2) "Bailing pits" in which the coral may be dug by a power shovel without blasting. In certain instances "push pits" developed into small "bailing pits."

(3) "Blasting pits" wherein all coral removed had to be first shaken up with dynamite.

Fig. 4. The largest "bailing pit" had six working levels and produced a total of 1,250,000 cu.yd. of good coral.

It was essential that all pits be located where they would minimize length of haul. However, a good "bailing pit" justified a relatively longer haul. Pits of this type were scarce, although 1¼ million cu.yd. was removed from one deep bailing pit in which as many as six levels were worked.

Throughout the construction period observations were made continuously on the characteristics of the coral with respect to density, hardness and color. Some of the field personnel were inclined to evaluate the coral by its color. A feeling prevailed that the whiter the coral the better the cementative value. This was not found to be a reliable criterion, because the coral removed from the largest bailing pit, which was yellow in color, had a high cementative value as compared with some very white coral taken from a blasting pit. However, the tests did indicate that if white and yellow coral are removed from the same area, the lighter coral is usually better.

Layout problems

Seldom, if ever, will the engineer be confronted with more complex layout problems than were met on Tinian in the location of hard stands. It was necessary that taxiways should be of minimum length, should be kept within the required gradient and should meet all security regulations as to spacing and other protection. The big planes have to have clearance for taxi operations and the 1½ percent grade limitation had to be met even in close quarters where elevation differences ranged up to 58 ft.

The heavier fills were required at North Field where a deep ravine near the midpoint of the field ran normal to the several runways. Some of these fills were on the order of 42 ft. high, 600 ft. wide and 2,000 ft. in length. Two that averaged 25 ft. in depth were 3,700 ft. long and there were numerous others 10 to 15 ft. deep. Careful adjustment of the center lines of the runways was made with a view to the most economical earth-handling program possible.

MAJOR ITEMS OF EQUIPMENT USED ON THE TINIAN AIRBASES

Dump trucks	570
Cargo trucks	200
Power shovels	80
Pans (carrying scrapers)	160
Rooters, 6-ton	12
Wagon drills	90
Bulldozers and tractors	160
Compressors	90
Motor patrols	60
Rollers	48
Tournapulls	13
Sprinkler trucks	40
Electric welders	70
Well drilling rigs	5

Two multiple-strip airdromes with long, heavily paved runways represent the movement of a total of some 9,000,000 cu.yd. of coral. About half of the coral excavated was hard enough to warrant blasting, though dynamite was not always used where it would have been desirable. All runways, taxiways and hard stands were finished with specially compacted coral surfacing 6 to 21 in. deep (averaging about 18 in.). Altogether, the area of this thick surfacing totaled about 58,000,000 sq. ft.

Real work for men and machines

Despite three additional battalions with special equipment, brought in to augment the efforts of greatly overburdened forces that started the project, throughout a major part of the construction program the forces worked 10 hr. a day, 7 days a week. Equipment was used for two 10-hr. shifts daily with but 4-hr. for service and maintenance out of the 24. At no time during the construction period was there any excess of personnel or equipment; shortages of both obtained in the early stages.

The major equipment used on the Tinian airbases is shown in the accompanying table. In this list, which covers totals after all shipments came in, there was a great shortage of wagon drills. All of those on the is-

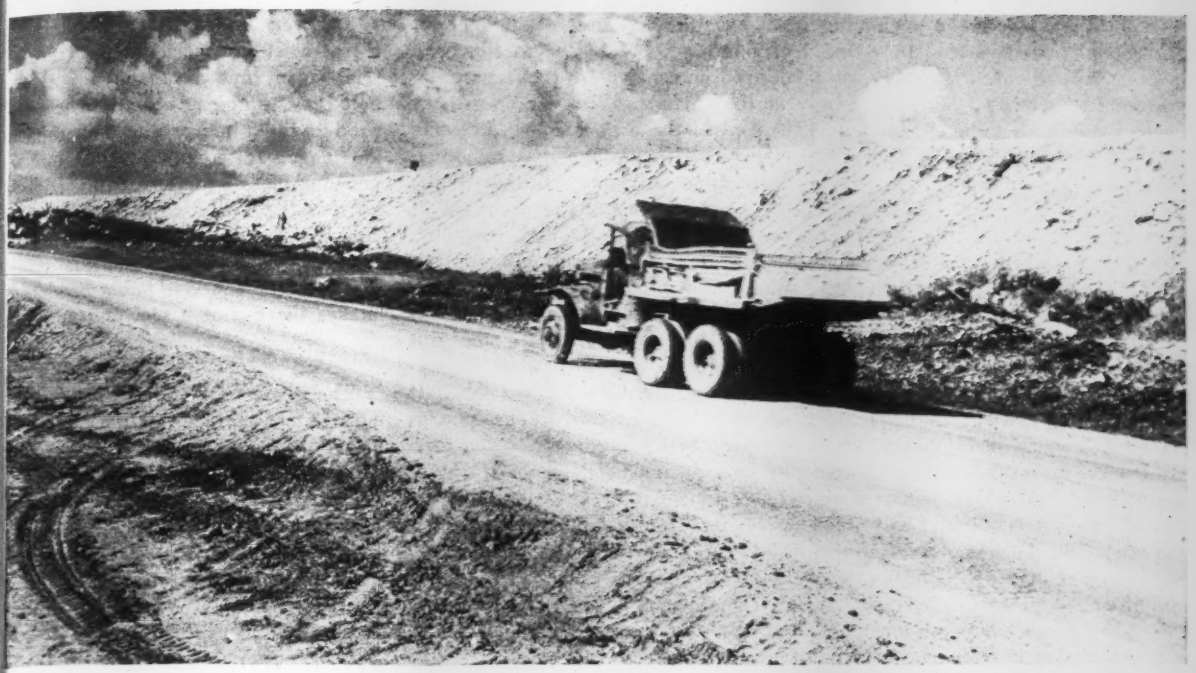

Fig. 5. Typical appearance of a taxiway fill on North Field. Road in the foreground is surfaced for heavy hauling.

land had to be used in the pits on the hard coral that required shooting before it could be taken out.

Equipment breakdown was always an important item. Even on the heaviest power shovels cables frequently wore out in three days because the material handled was so hard. Wagon drills were overhauled three times a month and pans and rooters required 24-hr. maintenance crews, welding continuously to keep the equipment working. The character of material handled frequently put a large percentage of equipment on the deadline and spare parts had to be flown out from the states. Handicaps were imposed by inability to exactly time simultaneous arrival of personnel and equipment plus the fact that practically all construction equipment had to be brought across the beach instead of being landed in a harbor.

It is gratifying to record that despite all difficulties all firm dates were met; in many cases planes were landed as much as 10 days in advance of strip-completion schedule.

Rooting and panning were the preferable methods of excavating coral wherever this was practicable. Very hard coral "heads," which are classed as crystalline limestone, were frequently encountered and these always slowed operations. On the first strip, 6,000 ft. long, about 400,000 cu.yd. of coral had to be hauled an average of 3 mi. Before arrival of rigs needed for blast-hole drilling, a heavy bank of coral that normally would have been blasted had to be cut down with the pans. This rough usage, with resultant high maintenance and shortened life of the equipment, was considered necessary, in the absence of suitable equipment, as part of the cost of having the fields ready on time.

Early in the work it was the program so to drill the holes for blasting that the coral would be loosened to a depth of 1 ft. below subgrade. It was soon found that this necessitated follow-up to remove coral points protruding above grade. To reduce this clean-up grading, depth of the holes was increased 2 to 3 ft.

Pilot cut found helpful

The first strip on West Field involved a cut about 14 ft. deep, 600 ft. wide and 2,500 ft. long. The working plan was to drill and shoot, sometimes as much as 56 tons of dynamite in one blast, following up with transverse cuts at either end with cranes, shovels and trucks moving coral into adjacent fills. On the next strip a modification of this procedure was tried. A longitudinal pilot cut was made through the entire length of the cut, affording a much longer working face and thus materially increasing the efficiency of the operation. This pilot cut method was highly satisfactory. It permitted apportioning material to either side fill as required.

This coral was found to increase its bulk considerably in the process of excavation. The yardage handled by trucks, of course, was much greater than yardage in situ. The trucks handled about 35 percent more material than compacted fill yardage. This factor should not be forgotten in planning the amount of equipment required.

In the compaction of coral the optimum moisture content is not such a critical matter as it is with other materials, clay for example. Long hauls and the lack of sufficient water trucks made it impracticable to apply enough water to give the prescribed moisture content. However, compaction tests of the completed surface, especially those that had been placed in small lifts that could be compacted with a sheepsfoot roller, showed densities practically as great as if the specified moisture content had been obtained. After this discovery, as a means of speeding the work, salt water which is known to be the best stabilizing agent for coral, was not used except on the surfacing.

During the rainy season pneumatic rolling, which had been a recommended method of surfacing with coral found on other islands, had to be abandonded on Tinian. Attempts at pneumatic rolling left ridges in the surfaces that retained water and thus delayed finishing. A preferable method was to place the coral in low lifts, bulldoze it to uniform grade, rapidly sheepsfoot it and then immediately roll with flat rollers. This modified method proved to be so speedy that it was continued even after the rains ceased.

On deep fills it was found that the pocketing of water during heavy rains would cause unstable sections if the relatively flat transverse grades were maintained. Accordingly, all fills were started on the center line and the lifts were brought up with not less than 5-percent cross grade until the top level was reached, giving speedy runoff. In final surfacing, working with cementative coral, the transverse grade was successfully brought up to meet the flatter grade specified. This procedure is worthy of special emphasis and to it may be credited success in completing fills without delay where the depth was 40 ft. or more.

In finishing the coral surfaces a honing procedure with motor patrols was extensively used to bring the fines to the surface. At this stage it was essential that an adequate amount of salt water be applied to effect the desired cementing of coral particles on the surface. This was necessary to control the dust nuisance in early operations. Although it is suggested that these surfaces ultimately be topped with asphalt as a means of controlling dusting and raveling, during the early operational stages it was found imperative that salt water be used continually as a dust palliative. The effectiveness of the salt water sprinkling was well demonstrated by the durability of the first of the Tinian fields to be put in service. This single strip was used by several squadrons from Nov. 15, 1944, to April 1, 1945, without the necessity of resurfacing.

Some surfacing needed

The asphalt surfacing program on Tinian, as presently contemplated, involves the use of about 500,000 tons. Asphalt is spread on the runways to a depth of 2½ in. and is compacted to slightly more than 2 in. This surfacing weighs 120 lb. per cu. ft. The coral base in itself is tightly cemented and with the asphalt topping it is believed that the entire structure will be stable against any appreciable permeability during the rainy season.

To assure desirable asphalt quality, aggregates are selected carefully and stored under cover to guarantee at least surface drying. The asphalt plant has a capacity of about 2,000 tons daily, turning out the final product at a temperature exceeding 200 deg. Tests show a dense homogeneous mass and thoroughly coated particles. While consideration has been given to the application of a seal coat, it is believed that the quality of the asphaltic concrete being produced makes the use of a seal unnecessary.

Administration

The projects in the Marianas were on a scale so much larger than the usual assignments for construction battalions that something quite different from the ordinary administrative control was obviously necessary. However, it was desired to avoid disturbing the widely endorsed battalion integrity any more than necessary. Accordingly, a brigade was organized for the purpose of integrating the construction activity on the larger projects. The brigade was composed of three regiments and for this project a combined brigade and regimental staff was set up.

Brigade and regimental staffs occupied the same headquarters for close coordination of construction policies and activity. The two staffs were streamlined with the intent of having them function mainly as an administrative agency. Only preliminary designs and sketches were laid out by the group of officers called "operations and planning," after which the detailed studies were farmed out to the battalions via the regiments.

Many of the projects, such as the large fields, were beyond the capabilities of the men and equipment of one battalion. A system was adopted which established on each strip or each natural subdivision of the work a lead battalion much like a contractor who was held responsible for coordinating all efforts on that particular project. It was also charged with the detail of planning, the scheduling of operations and the reporting of progress.

Supporting this lead battalion, to which task orders had been issued, were parts of other battalions, much like subcontractors, to which the lead battalion issued shop orders to reinforce its men and equipment to an extent predetermined by the brigade and the regiment.

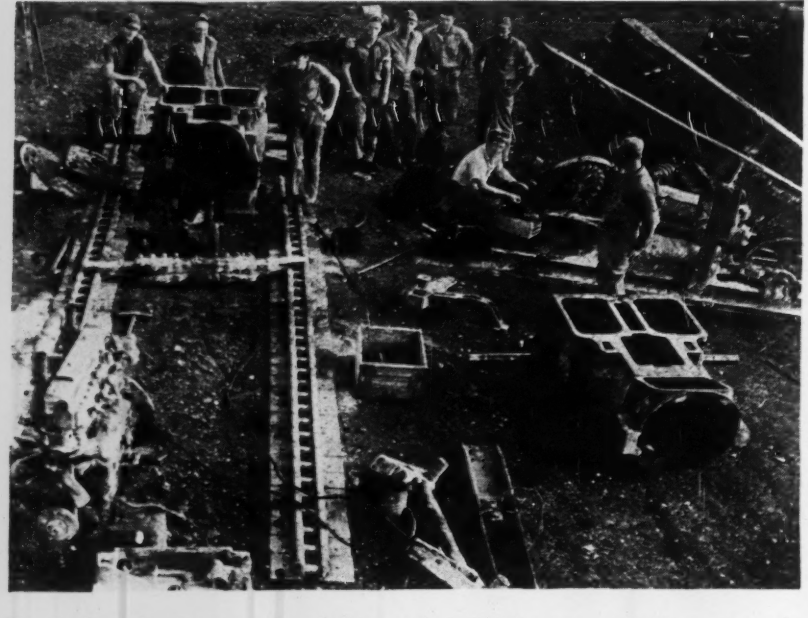

Fig. 6. Abrasion from coral and damage from hard usage made it necessary to completely overhaul tractors frequently.

This basic principle permitted each battalion, in rotation, to enjoy the full responsibility of operating a very large project. The lead battalion changed simultaneously and consecutively as the construction of each strip was completed. In several cases even the capacity of a regiment was taxed to the extent of requiring a combination of regimental efforts.

Coordination emphasized

The value of this plan of coordinating effort cannot be emphasized too strongly for these tremendous projects, particularly where it is necessary to make efficient use of many types of equipment. The brigade staff continually analyzed the distribution of personnel and the allocation of equipment. Although equipment normally is assigned to each battalion, the magnitude of the earthmoving operation on this project justified relatively frequent exchanges between the battalions and regiments.

The movement of coral by truck did not permit of battalion assignments for this part of the work. All trucks had to be pooled in order to maintain rapid delivery where it was most urgently needed. In this particular phase of the work the usual system of delegation to the battalions was broken down in favor of pooled operation. It is to be noted, however, that this was successfully coordinated by brigade representatives and that a spirit of competition was developed by recording the quantities hauled per truck by battalions.

Great benefit was derived from special haul roads following the shortest practicable routes from pits to destination. These were rated as high-speed roads on which normal traffic was 35 m.p.h. Only vehicles with special signs were permitted on these roads and traffic was controlled by construction force police stationed at principle intersections 24 hr. per day. These men were chosen for this work instead of military police because the construction troops by training have a better understanding of the need for expediting traffic and for giving priority to trucks hauling coral.

Friendly relationships

A factor that greatly eased the administrative problem in endeavoring to do the impossible was the lack of need for applying the pressure usually associated with an enormous construction project. Of their own volition the men worked like demons with but little thought of their own physical fatigue. They realized that they were directly contributing to the war effort by providing facilities that were making possible aerial attacks on Japan.

This high morale was aided by the close relationship between the construction forces and operating personnel of the air force, resulting ultimately in every battalion sponsoring one plane. Also, each regiment and the brigade sponsored one. Following the painting on the ship of the insignia by the unit sign painters, flight officers and men visited their respective Seabee units for dinner and a little celebration. After that the officers and men of the sponsored ships spent much of their relaxation time in the Seabee camps. In turn the men in the field occasionally were given rides in the B-29s, and in a short time they exhibited the same interest and spirit in the missions as did the flight personnel themselves.

It was not unusual to see Seabees who had already worked 10 hr. going to the field on their time off to wait for these ships on their return from Tokyo—to "sweat them in" and to welcome the crews back to the base. Men of long experience in the construction industry have remarked that never have they observed construction men who worked as arduously and as spiritedly as they did to provide the Tinian Island facilities for these great Superfortresses.

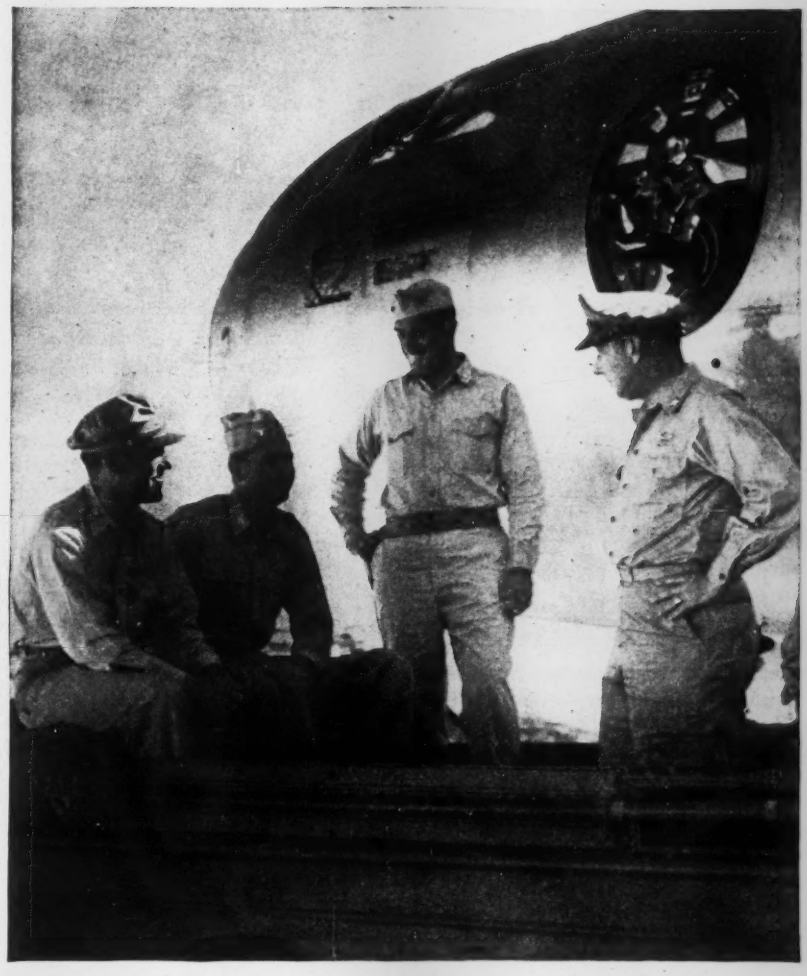

Fig. 7. Four "brass hats" inspect the field. Left to right: Col. Walsh, deputy wing commander; Gen. Davies, wing commander; Commodore P. J. Halloran, Seabee brigade commander; Gen. Frederick V. H. Kimble, island commander. Note the 6th CB Brigade insignia on the Superfortress, in recognition of the Seabees contribution to the bomber's operation.

Iwo Jima's Caves and Tunnels

Lt. Comdr. W. J. Thompson
Civil Engineer Corps, U. S. Navy

***Contents in Brief**—Volcanic ash on Iwo Jima is an ideal material for tunneling as it cuts easily yet stands without shoring. Bombs and shelling do not penetrate or shatter the ash and therefore the caves were effective protection against all measures except sealing them up.*

MUCH HAS BEEN WRITTEN on the fighting at Iwo Jima but little on the engineering structures of the enemy. After the ceaseless bombardment necessary to capture the island, there were no engineering structures to describe except the cave installations. These alone remained and from the underground tunnels the Japanese continued to fight even after the island was "secure."

Iwo Jima is an island composed of two volcanoes. The larger of the two makes up the central portion of the island. At the southern tip is Mount Suribachi, which towered some 540 ft. above the Pacific before the Marines arrived and the Seabees began changing its profile.

As the Marines pushed into the central and northern portion of the island, the Japs retired to caves to continue the defense of Iwo Jima. The cave system from which they fought was both elaborate and extensive and was an integral part of the island defenses.

Prisoners stated that the garrison force was moved underground to escape the daily bombing that was a part of the pre-invasion softening-up process. The caves provided security as those aerial strikes caused few casualties. The effectiveness of the cave and tunnel system as a means of passive defense reflected in the heavy casualties sustained by the Marines.

Construction of caves on the island of Iwo Jima posed no extraordinary engineering problems. The prime need was manpower for miners and muckers. Nature provided the other essentials—the rough terrain is indented by deep draws and crevices that facilitated concealment from land, sea and air; the soft cemented volcanic ash is easily worked by hand tools.

The outward appearance of the ash is that of hard rock but the appearance is deceptive. The material is highly resistant to missiles and fragmentation and does not cleave easily. It is ideal for tunneling and stands without shoring.

In its natural state the consolidated volcanic ash weighs about 90 lb. per cubic foot. It is easily ripped loose with a heavy three-tooth rooter and can be readily cut by carrying scrapers. Power shovels and bulldozers can move any formation or pinnacle with ease.

Fig. 1. Tunnels in Iwo Jima's volcanic ash dug easily and required no shoring but Japs did not make them high enough to permit standing erect. These tunnels were an integral part of the island's defenses.

The Japanese employed caves for headquarters installations, supply and ammunition dumps, radio stations, hospitals, warehouses and living quarters. Many of the caves had entrances in close proximity to surface defense installations. Establishment of living quarters appears to have been a secondary consideration. Even in the most extensive tunnels living quarters were poor and inadequate.

Construction of the caves varied widely, ranging from small holes to extensive tunnels with no apparent standard plan being followed. However, one standard did appear and that was the placing of the entrance tunnel perpendicular to the face of the cliff with "T" formations cut at varying distances from the entrance.

In general the caves appear to have been individually planned to fit specific requirements for the adjacent defensive unit or installation. Some tunnels have been discovered that were connected to natural caves. The entrances to most caves are small and it is necessary to stoop or crawl into them to gain entrance.

The main tunnels are usually about 8 ft. wide and not more than 6 ft. high. Seldom is the width of a tunnel found to exceed 6 ft. Pockets about 8x3 ft. and 5 ft. high are cut in the wall for living quarters. Other niches of appropriate dimensions are provided for small-arms racks, personal acoutrements and military gear.

In no case was there any evidences of shoring or reinforcement to support the tunnel roofs. The arched section cut in the cemented volcanic ash appears to have adequate structural strength.

Ventilation of a sort

Ventilation was provided by air shafts which were located as nearly as possible in the cave center. No apparent attempt was made to proportion the area of the shaft to area of the cave being ventilated. The many shafts and entrances are relied upon to furnish air circulation for the occupants and for the dissipation of heat from operating equipment.

Fig. 2. Ash looks like hard rock but is soft enough to cut readily. Note teeth marks from 1½ cu.yd. shovel dipper.

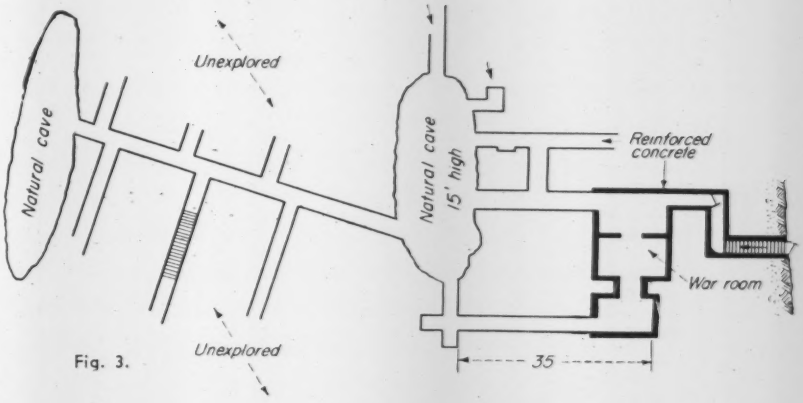

Fig. 3.

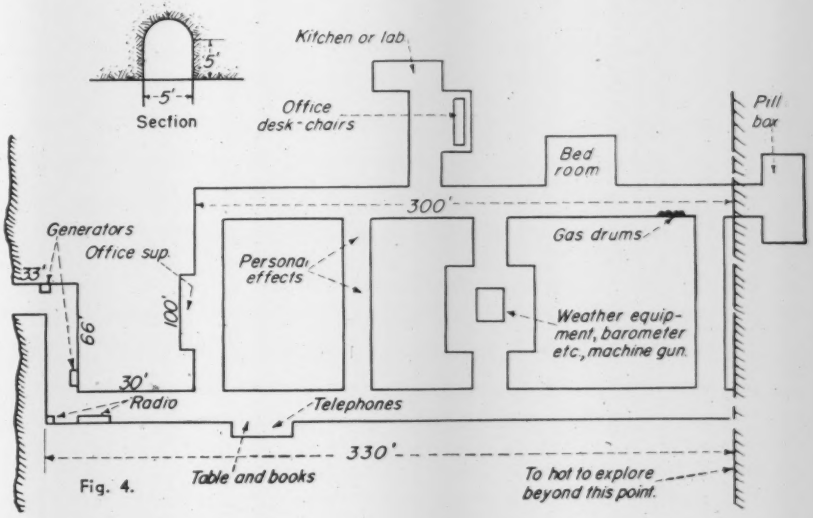

Fig. 4.

Fig. 3. The commanding officer's cave (above) had an elaborate labyrinth of passageways on two levels.

Fig. 4. Naval headquarters cave (below) was well protected. It is believed to connect to other caves but heat from ground prevented exploration.

Fig. 5. Niches cut in the walls formed sleeping space in the caves.

After closing the caves and air shafts, the interiors frequently became uninhabitable from the heat. High underground temperatures are often encountered in volcanic regions and the Iwo caves were no exception. Temperatures in some of the closed caves were estimated at 135 to 160 deg. F.

The commanding officer's headquarters cave, Fig. 2, is the most elaborate discovered to date. The system included space for ordnance, finance and communications and was located only a short distance from the adjutant's section, housed in a separate cave system.

The entrance to the general's room or war room is from a former garden in a rugged draw and the passage is lined with concrete and complete with steps and hand rail. The steps lead down about 25 ft. to a small anteroom about 5x5x5 ft. Below this room is another of about the same size accessible through a trap door in the floor. Adjoining the anteroom is a second room 10x5x5 ft. and another of the same size is connected directly to this one. Access between rooms is through openings some 3 ft. square.

The Naval headquarters cave is shown in Fig. 3. It is probably connected to other systems in the vicinity and with a surface radio station well protected by reinforced concrete. Much radio, electrical and metrological equipment was found inside indicating that it was a sizeable headquarters. Air vents had been closed and the rear portions of the cave were too hot to fully explore.

Most caves have more than one entrance and some have been found with three levels with the bottom level at least ninety feet below the surface. The multiple entrances to a single cave handicapped "mopping up" operations. The maze of branch tunnels and the many niches often protected the enemy from blast concussion and while one entrance was being closed he would escape or dig out at another exit that had escaped detection.

The interiors of many caves have never been fully explored or investigated, as a belligerent enemy made it necessary to seal them with explosives, usually TNT, to avoid casualties. The presence of the caves had little more than a harrassing effect on the Seabees as combat troops cleared the way.

Development of the Iwo base proceeded at a rapid rate despite the caves. Digging out an enemy that retires to caves and continues to fight is a difficult task, however, causing heavy casualties and requiring great quantities of materials and equipment.

Mexico to Finish Inter-American Road

Mexico's section of the Inter-American Highway from Laredo to Tapachula, on the border of Guatemala, a distance of 1,645 miles, will be completed by the end of 1946, reports Pedro Martinez Tornel, Mexican Minister of Public Works.

The Minister's statement, according to information received in Washington, reviewed construction progress on the highway.

The highway is now paved from Laredo to a point 60 miles south of Oaxaco. From that point to the Guatemalan border is a distance of 565 miles, of which 165 miles in broken sections have been finished.

By the end of 1945, according to Minister Tornel, the highway should be completed as far as Las Cruces, leaving 263 miles south to Tapachula to be completed in 1946. The Minister pointed out that the speed with which the program can be carried through will depend on financing, availability of materials, weather and other unpredictable factors. In any case, he said, at least 90 percent of the Inter-American Highway in Mexico should be completed in the next 18 months.

Mininster Tornel reported that work also was going forward on the Mazatlan-Durango link in the inter-ocean highway between Mazatlan and Matamores (near Brownsville, Texas). The Mexican Government, he said, would do everything possible to complete by 1946 the new rail connection with Yucatan and Compeche.

The new railroad in turn will be connected with the Inter-American Highway by a branch highway running from the rail line at Teapa to the highway at Tuxtla. This network of rail and highway will bring the States of Tabasco and Chiapas in touch with through transportation routes.

The Government hopes to complete soon the Sonora-Baja California line connecting Mexicali with the Southern Pacific of Mexico at Santa Ana, Sonora, and to push through work on the extension of the Kansas City, Mexico and Orient Rail-Road to the port of Topolobampo, Sinaloa.

BEGINNING A SPECIAL SECTION ON

Water Supply

★

FEATURING

Industrial Process Water Supply • Repairing Chicago's Water Meters

Groundwater Development on Guam • Improvised Pressure Chlorinator

Water Use Map for Ohio

WATERWORKS designers, operators and administrators have performed a stupendous task during the war years in maintaining a vitally essential service under exceedingly difficult conditions. For this they have received no medals or "E" pennants. Their only reward can be the satisfaction of jobs well done, some examples of which are described in the following pages.

EQUALLY GREAT should be their satisfaction for having also made preparations for the job ahead. Now that "postwar" denotes present reality rather than some indefinite future period, fruition of advance planning is about to be realized. Not only can the backlog of deferred waterworks maintenance (estimated by some authorities to represent about $100 million) get underway in short order, but of the $790 million in proposed waterworks projects reported to *Engineering News-Record* already $57 million, or 7 percent, are ready for bids. In addition, plans for some $501 million of work, or 64 percent, are in various stages of completion.

SUPPLYING safe and adequate water to meet the nation's needs is estimated to require an expenditure of over $2 billion for construction alone during the next decade. To meet this objective is a bold challenge. And waterworks men, and the manufacturers who supply materials and equipment, should look with confidence to the expansion of the function to which their efforts are dedicated—more and better public service.

Industrial Water Supply Features Siphon Intake and Submerged Pumps

L. N. Reeve
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Boston, Mass.

***Contents in Brief**—When available groundwater supplies, at Eddington, Pa., proved inadequate, an 8.6 mgd. process cooling water supply was developed for a new alcohol butadiene plant by installing a siphon intake from the Delaware River to twin caissons at the river bank. Continuity of supply is assured by the dual pump installation using the caissons as sumps.*

AN AMPLE and dependable source of process cooling water constitutes one of the essential requirements in many manufacturing industries. It is a definite "must" in such processes as manufacture of butadiene from industrial alcohol, since any interruption of the cooling water supply would occasion a complete shutdown of the plant, entailing total loss of the products in the distillation process. This loss would result from discharge of the valuable byproducts to the atmosphere when excessive temperature rise caused safety valves to open.

Consideration of this problem was a major factor in selection by the Publicker Commercial Alcohol Co. of a site at Eddington, Pa., for construction of an alcohol butadiene plant. It was known that an adequate water supply could be obtained from the Delaware River and it was thought that an underground supply might also be available. This latter alternative was considered because nearby there are shallow wells of fair yield.

Well supply found inadequate

In order to thoroughly survey the possibilities of using an underground source, a test well about 35 ft. deep was driven near the bank of the Delaware River and within the property line. This well produced water having a temperature of 50 deg. F. A supply at this low temperature would reduce cooling water requirements to a minimum—about 3,000 gpm.—with a corresponding reduction in power consumption compared to that necessary if the warmer river water were used. Accordingly, several test borings were made to bedrock, which in this locality is 35 to 40 ft. deep. These borings, using 6-in. steel pipe, showed the strata below groundwater level to be fairly clean water-bearing sands and gravels suitable for gravel-packed wells.

Two wells were developed, after which discharge capacity tests of both were made. During these tests, observations on water levels at the various test holes clearly indicated that a continuous supply from each gravel-packed well could not be expected to exceed 300 gpm. Because of these flow and space limitations along the river bank within the property limits, not over 25 percent of the total estimated water requirement could be produced by gravel-packed wells.

Moreover, even if space had been available, a total of ten wells would be required. This obviously would be an undesirable installation from the standpoint of cost, interconnecting piping, fittings and controls. It was concluded, therefore, that no further investigation of an underground source was warranted.

River offers dependable supply

When the available groundwater supply proved inadequate the river source was investigated. High summer temperatures of the river water (about 85 deg. F.), made it necessary to provide a much greater supply than would have been required using the cooler well water. Also, the river supply would entail dredging an intake channel, for which operation state and local permits and the approval of the Delaware River Navigation Commission would be required. Nevertheless, it was apparent that the river offered the only acceptable and economical source. The next step, therefore, was to determine the most satisfactory and economical method of obtaining a continuous supply of at least 5,000 gpm. from the river.

As a result of investigation it was decided to install pumps of the deep well type in one or more caissons at the river bank, dredge an intake channel, and lay a siphon pipe to the caisson from the shore end of this channel. Consideration was given to the installation of one large steel caisson at the shore to accommodate two pumps and the alternative of two smaller caissons, each equipped with one pump.

One caisson too large

Several reasons justified the adoption of the latter scheme. The large caisson would have to be 100 in. in diameter to accommodate two pumps of the proper size installed side by side, whereas one pump could be installed in a caisson of 54-in. diameter. Also, the larger caisson would be difficult to drive through 40 ft. of sand, gravel and small stone while maintaining the requisite alignment. In addition, in view of the critical material situation at that time, heavy steel plate work for the large caisson could not be obtained within the time limit prescribed.

Considering the problem of minimizing the probability of a plant shutdown, the twin 54-in. caisson scheme permits either pump to be shut down for inspection, cleaning out the pump sump, or making repairs to the

equipment, since each pump is capable of handling the maximum water requirement of the initial plant installation.

When the twin 54-in. diameter caissons were finally decided on, they were located about 30 ft. from the river bank to allow space for a roadway between the pump house and the river (see Fig. 1). At this location, depth from ground surface to bedrock was indicated by borings as 37 ft.

First operation in sinking the caissons was to put down a 60-in. diameter caisson to a depth of 20 ft. Then the 54-in. shell was driven 37 ft. to rock bottom, after which a cable tool rig was used to drill out the center core. While setting the first unit, rock not indicated by the borings was encountered at a depth of 27 ft. This rock forced the caisson out of proper alignment so that three weeks were required to complete its installation. The second caisson, however, was completed in one week, thereby completing the entire caisson installation within the time scheduled for this work.

The caissons are ½-in. thick steel casings on 13 ft. 6 in. centers. Each of them is fitted with a special siphon chamber extending from the top of the 24-in. intake pipe to a point 7 ft. below extreme low water.

Approach channel to intake crib

Since the Delaware River Navigation Commission objected to an intake pipe extending out into the navigation channel proper, it was decided, with the Commission's approval, to excavate an intake channel extending from the navigation channel to a short distance from the river bank. This intake channel, about 400 ft. in length, has a bottom width of 40 ft. and is dredged to 10 ft. below mean water level. Side slopes of the channel are one on three whereas the shore end is graded to one on six. These slopes were found to be stable, although some paving was required at the shore end of the channel to prevent undue erosion at times of high winds.

Siphon intake piping to pump

From the intake crib, which is located at toe of slope at the shore end of the channel, a 36-in. dia. steel pipe ⅜ in. thick extends 140 ft. to a point 30 ft. from the pump house. At this point it branches into two 24-in. dia. pipes connecting with the caissons. All joints are welded.

Controlling water and intake levels are as follows: Maximum high water, +10 ft.; extreme low water, —3 ft.; intake pipe at crib, —9 ft.; pumphouse floor, +17 ft.; and top of intake pipe at pumphouse, +2 ft. With these conditions the maximum siphon lift is about 7 ft., of which 5 ft. represents the distance from minimum river level to the top of the intake pipes where they enter the caissons.

Each of the 24-in. dia. pipes, the top of which at the pumphouse is 5 ft. above low water, has a goose-neck or siphon within the caisson extending to grade —10 ft. This is to insure an adequate water seal for siphon action at extreme low river level and drawdown within the caisson. Two interconnected vacuum pumps automatically maintain a vacuum at the throat of the intake pipe siphons, this being necessary to avoid delay when starting up the pumps during low river level conditions.

Pumping equipment for the instal-

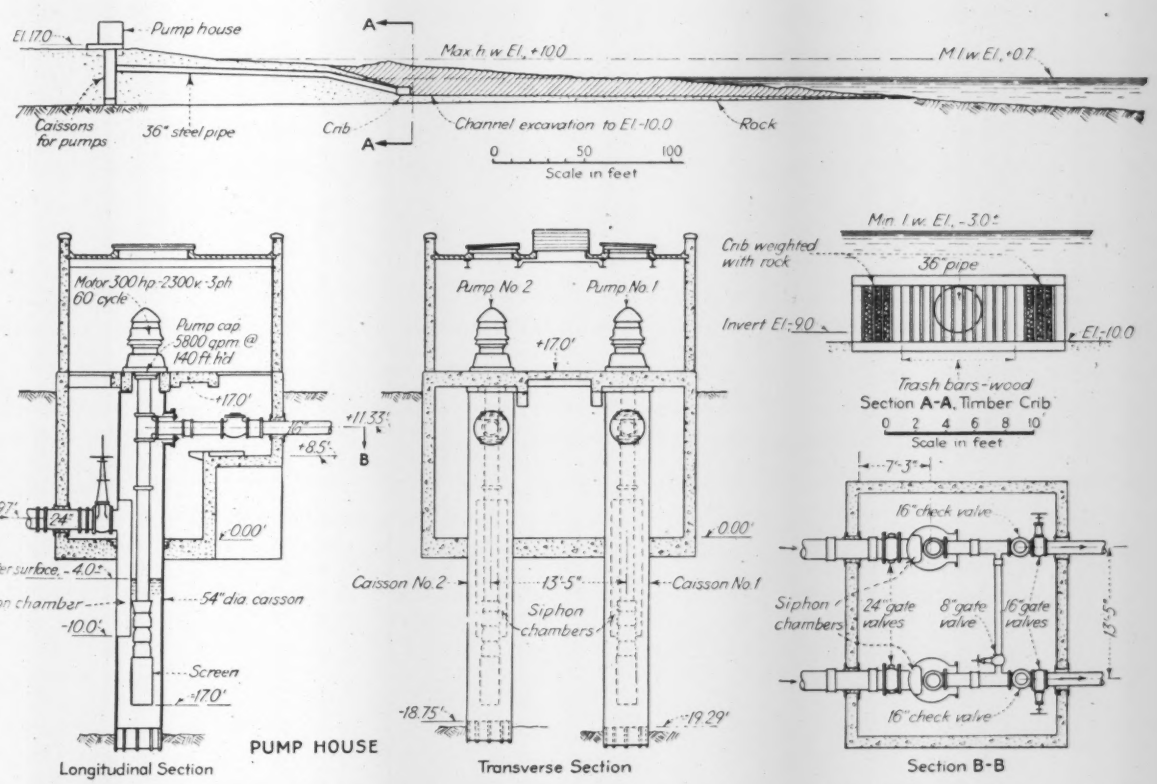


Fig. 1. Dual pump installation provides positive continuity of process cooling water supply for industrial plant. Note siphon chambers in twin caissons extending from the top of the 24-in. pipe to 7 ft. below extreme low water

lation is built around main units consisting of two vertical turbine pumps, each having a capacity of 6,000 gpm. at 154-ft. total dynamic head. Each of the pumps consists of two 2-stage, 24-in. cast iron bowls with bronze impellers and stainless steel impeller shafts. Five feet of 24-in. dia. silicon bronze shutter screen attached to the suction flange of each pump prevents river debris from entering the pump.

Prime movers for the pumps consist of two 300 hp., 1,200 rpm., 2,300 volt, 3-phase, 60-cycle, squirrel-cage, vertical motors. Priming is done with two vacuum pumps, each having a capacity of 110 cfm. under 12 in. of mercury vacuum. Each of the two vacuum tanks is 3 ft. in dia. and 10 ft. high.

Unwatering of the caissons is accomplished by a self-priming centrifugal pump, fitted with nonclog type impellers and having a capacity of 100 gpm. against a 40-ft. total dynamic head. It is designed for a 20-ft. suction lift.

In order to avoid constant supervision, the main pumps have full automatic control. Should pump failure or trash unduly affect the pump suction, alarm gongs and lights, installed at the pumphouse and also at the main process plant, are arranged to give necessary warning to the plant operating forces.

Combating silt, ice and trash

A river water supply installation at the location in question entails important problems having to do with silt, ice and trash, any one of which might seriously interfere with the continuous supply necessary for the plant. All these problems were successfully solved by the installation described.

Because of the large cross-sectional area of the intake channel during low river level conditions, velocities required to deliver water to the intake crib are so low that the channel functions as a desilting basin, thus preventing mud and fine sand from passing through the intake pipe to the pumps. These low channel velocities also aid in preventing movement of trash through the channel to the intake crib, but trash bars were installed at the crib as a secondary precaution.

The river carries a very low percentage of solids in suspension during low flow, but it was thought quite possible that during floods considerable amounts of sand might be deposited in the channel. This would necessitate periodic dredging. To date, however, sand deposits within the channel have been negligible.

Experience with water supply intakes upstream from the site shows considerable trouble from frazil ice, which condition is due to the intakes being too close to the river surface, or the entrance velocities being too high. Accordingly, the intake pipe at the crib was set 6 ft. below low water level. Although low velocity should reduce formation of frazil ice, a further safeguard against this condition is provided by a winter discharge line returning warm water to the intake crib. Another pipe, providing for discharge of return water during the summer months, is located a considerable distance down stream from the intake channel.

Careful consideration was also given to the possibility of an ice jam of such proportions as to plug the intake channel and shut off the water supply to the intake. After discussion with local river authorities, it was decided that the probability of such a condition occurring was so remote as not to justify any expenditure for its prevention.

With low velocity conditions in the channel and trash rack provided at the intake crib, little trash, if any, should enter the intake pipe. Nevertheless, each pump has a specially designed screen at the suction end to prevent trash reaching the pump impellers and thus passing through to the distribution system. Total net area of the screen openings, which are of a patented, slotted, nonclog type, is such that the pump would continue to operate with 75 percent of the screen plugged.

Those in charge

The writer supervised the design, preparation of drawings and specifications and selection of equipment for this installation, which was completed in the spring of 1944.

Designs and construction for this plant were made by Stone & Webster Engineering Corp., subject to the approval of C. L. Gabriel, vice president of the Publicker Commercial Alcohol Co., which was the owner.

Superintendent of construction was R. E. McGrew.

Principal equipment manufacturer for the water supply installation was the Layne-New York Co., Inc., who furnished the two vertical deep well pumps and sank the steel caissons in which the pumps were installed.

Huge Map of Ohio Helps Planning for Water Use

The largest topographic map of Ohio ever made—23 feet wide and 32 feet deep—has just been completed to show at a glance all the data on Ohio's water supply. The map, made up of the 220 U. S. Geological Survey quadrangles that cover Ohio, is the work of the Ohio Water Supply Board.

The huge map is thought to be the only one of its kind, as the U. S. Geological Survey, when asked for guidance on putting the sections together, replied that such a thing had never been done before.

The map is hung on rollers 24 ft. wide and are 8 ft. apart so that a section of Ohio complete from east to west and one-fourth the width of the state from north to south can be inspected at one time.

Boundaries of the watersheds, as well as reservoirs and proposed reservoirs have been placed on the basic topographic maps. Stream gaging stations and the boundaries between secondary streams are also shown.

It is planned to put on the map all water supply requirements throughout the state and all ground and surface water capabilities so that areas deficient in water will be clearly marked. When this is done, it will be possible for the board to plan proper ground water recharge measures and surface water storage as a solution to Ohio's water problems.

Additional funds were recently appropriated so the agency, which will soon be known as the Ohio Water Resources Board under a new law, could expand its investigating program.

Chlorinator for Pressure Service Improvised from Salvaged Materials

WHEN immediate chlorination of certain German municipal waters was ordered by the Army, a successful chlorinating unit was improvised from salvaged parts of wrecked or captured equipment entirely foreign to the waterworks field. A local glassblower fabricated the parts needed to prevent damage to the gages by back-flow from the main.

While a captured German gas-welding diaphragm valve was available, it would not fit American gas cylinders. To overcome this difficulty the brass screw-on cap of the chlorine cylinder was drilled and then brazed to the diaphragm valve inlet. The valve was also refitted with American low-pressure gages taken from the instrument panels of wrecked trucks. One of these gages, formerly an oil-pressure indicator, now shows chlorine delivery pressure.

Chlorine is carried from this revamped regulator (Fig. 1) through ¼-in. inside diameter rubber hose, previously used for tire inflation, to a glass check-valve protecting the gages against backflow due to excessive water pressure.

This glass valve (Fig. 2) consists of a hollow glass float free to move vertically in a glass cylinder. Closure is made at its upper end by means of a ground glass seat. Four projections on the float keep it centered in the cylinder and prevent closure at the lower end, thus permitting chlorine to flow into the main but preventing the chlorine-and-water mixture from backing up. The glass valve is held upright by a small metal bracket (see Fig. 1) brazed to the special brass injector fitting tapped into the main.

Made of ¼-in. glass tubing, the injector (Fig. 3) is L-shaped, with a pinhole orifice in the end of the short leg. When installed in the main, this jet points in the direction of water flow. Pipe reducer bushings of suitable size serve as a packing gland and hold tube firmly in the pipe wall against water pressure.

Calibration of delivery gage readings with colorimetric titration of the treated water aids in accurately maintaining the 1.5- to 2.0-ppm. chlorination specified. This holds true because flow in the pipe is practically constant, the supply going to overhead storage when not used directly. Main pressure is 65 psi.

The unit is used chiefly on mains supplying large building groups, such as permanent hospitals or camps.

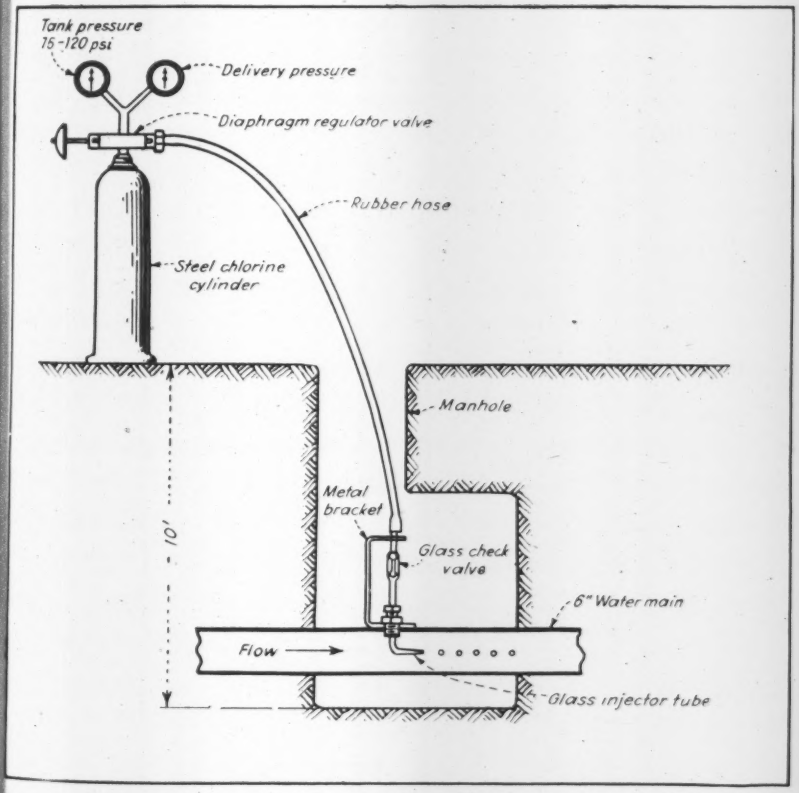


Fig. 1. Emergency chlorinator for use on water mains of a German city was improvised with parts salvaged from captured and wrecked equipment.

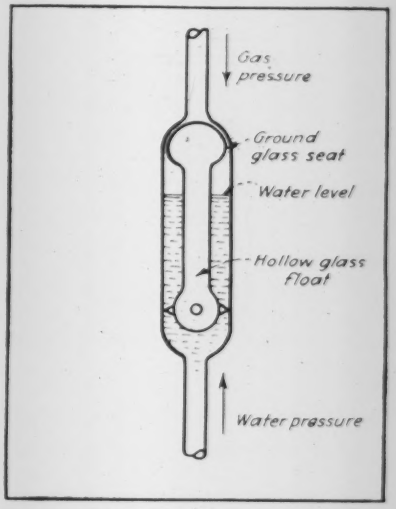


Fig. 2. Back-pressure valve made by local glass blower prevents water from reaching valves and gages likely to be damaged by gas and water mixture.

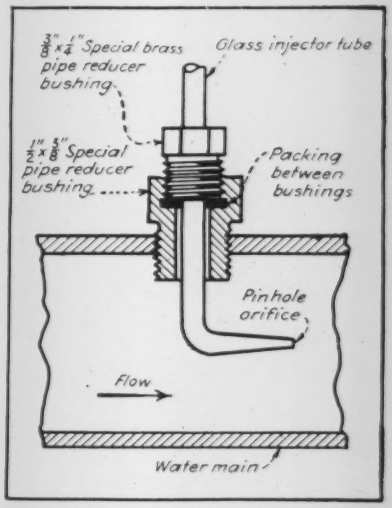


Fig. 3. Glass injector tube with pinhole orifice is tapped into main through improvised packing gland, which holds tube firmly against water flow.

Groundwater Development on Guam

Lieut. (jg.) Glen H. Abplanalp
Civil Engineer Corps, U. S. Naval Reserve

***Editor's Note**—Adequate water supply for an important advanced naval base is obtained from a lens of fresh water "floating" on salt water in pervious limestone formations underlying Guam. The danger of salt-water incursion resultant from drawdown has to be avoided and underground skimming weirs, similar to those used in Hawaii (ENR Mar. 25, 1937, p. 450), afford best means for meeting heavy demands. In the Guam climate chlorides as high as 650 ppm. are considered permissible in potable waters. The author is a 1936 civil engineer graduate of Rensselaer Polytechnic Institute and before entering active service was employed by the Wallace and Tiernan Co.*

THE POTENTIAL SUPPLY of fresh water on Guam, largest land mass in 10,000,000 sq.mi. of ocean area, has been of great importance to the Navy during the steady advance of our forces into what was once classed as "Japanese waters." Like other Pacific islands with similar geological history, Guam has considerable quantities of fresh water stored in the lens below ocean level within the pervious limestone underlying parts of the island. This supply is regularly replenished by the heavy annual rain.

In order to withdraw the maximum amount from this storage without risking the incursion of salt water into the low-level lens, the conditions under which fresh water will remain below sea level must be clearly understood. The currently developed fresh-water supply on Guam as this was written was 11 mgd. from a 225-sq.mi. island surface. Plans were under way for increasing this supply to 15 or 20 mgd. How this supply can be maintained will be apparent from the following, in which it is necessary to first tell something of the island's geography and geology.

Bigger than all the other Marianas combined, Guam is only 1,200 mi. from Japan and from the Philippines. Roughly oblong in shape, the island is about 8 mi. wide and some 30 mi. long. The northern half is covered by a limestone plateau through which protrudes Mt. Santa Rosa; the southern half, chiefly of volcanic origin, is composed of broken mountain areas with several summits more than 1,000 ft. above sea level. For data about geology of the island, the writer is indebted to Dr. Harold T. Stearns, U. S. Geological Survey.

More than a million years ago a weakness in the earth crust allowed lava to flow into the ocean floor, resulting in violent eruptions and the building of a submarine volcano. Subsequent to this there were periods of folding sedimentation faulting, emergence and submergence. In one period, during which Mt. Santa Rosa in the north and the mountainous regions to the south were two separate islands, extensive coral reefs were formed. Later the two land masses were uplifted and intervening shallows emerged to form what is now Guam. The northern half, a huge coral formation, has been raised several hundred feet above water to form the northern limestone plateau, while the mountains of the south are capped with coral in several places.

This limestone, being a fairly good aquifer, is responsible for the presence of an abundant groundwater supply in the northern half of the island. Under the conditions there obtaining this fresh groundwater floats in a lens on the denser salt water.

The structure of the island and the fresh-water lens in the northern limestone area are shown in the accompanying sketches. The water lens, or "bubbles," result from rain water percolating down through pervious material but remaining above the denser salt water. There is, of course, no distinct line of demarcation between fresh and salt water. Fresh water is separated from the salt by an intermediate brackish zone in which salinity increases gradually.

First observed in 1887 by a Dutch

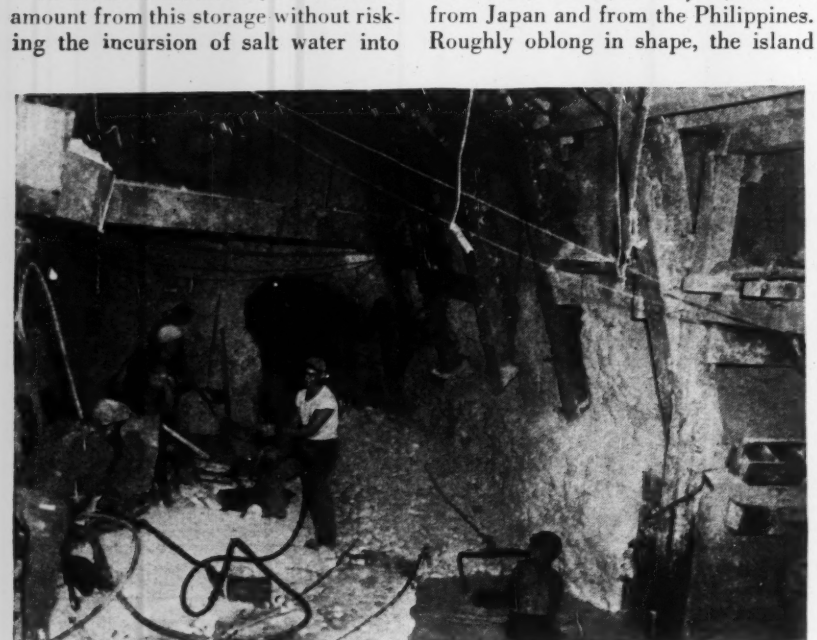


Fig. 1. Excavation for underground pump room, which will also house skimming weirs. Entrance to 150-ft. water drift in background.

engineer, Badon Ghyben, this phenomenon of a lens of fresh water floating on salt water was later (1900) investigated by Herzberg. He found that the lens acquired a shape similar to that shown on Fig. 3, the equation for which he expressed as follows:

$$h = \frac{t}{.g - 1}$$

where: h is the depth of fresh water below sea level in feet
t is the height of fresh water above sea level in feet
g is the specific gravity of sea water

Generally speaking, for every foot which the lens extends above sea level, the fresh water extends about 40 ft. below, a ratio which varies slightly depending on the density of the salt water. The fresh water is always in motion, flowing from the center of the lens out toward the edges. This actually can be seen along the northern shores of Guam during periods of low tide, where fresh water flows in tiny streams from the sand beaches out to the ocean.

In a few instances where solution channels have been formed, concentrated flows up to several hundred gallons per minute have been observed. Because of the ease with which water flows through this coral limestone, the fresh-water lens is relatively thin, with the groundwater only about 5 ft. above sea level at the lens center and extending about 200 ft. below sea level.

With this basic knowledge, the following methods have been used in the development of the groundwater supply: (1) Shallow wells along the coastal areas, (2) deep wells in the interior, and (3) basal groundwater tunnels with skimming weirs for the development of large supplies.

Shallow and deep wells

Various types of shallow wells were developed: Well points, drilled holes with slotted casing, and large dug wells. The dug wells, 8 to 10 ft. square and extending 3 ft. below groundwater level, are the most successful in keeping chlorides low and producing large flows with safety. One such well is located only 300 ft. from the beach and is producing about 65 gpm. without any salt intrusion. Other dug wells located farther from the beach are producing as much as 250 gpm. with only a few inches of drawdown.

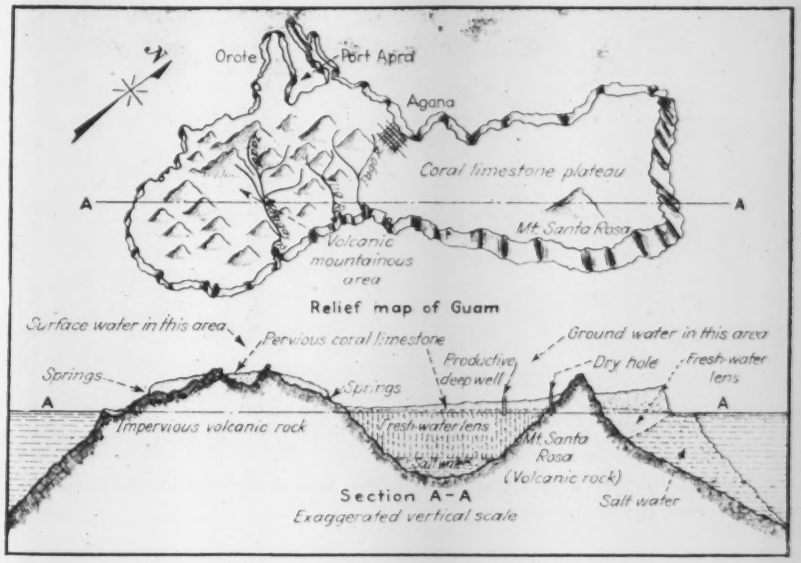


Fig. 2. Guam Island shown in relief and in cross-section. Lens of fresh water in the pervious limestone "float" on the salt water.

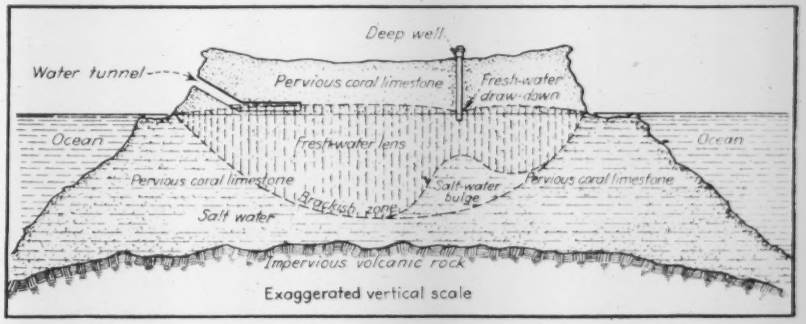


Fig. 3. Salt water bulge forms under heavy drawdown on deep well. Tunnel at left avoids drawdown by skimming surface of fresh-water lens.

A standard cable-tool rig was used to drill deep wells in developing the principal body of the groundwater supply. The main wells were drilled for 12-in. or 14-in. well casing, depending upon what was available at the time. Drilling logs revealed marked variations in the coral limestone formation from extremely hard to very soft material. In some cases large underground cavities were met.

To reduce the hazard of salt-water contamination, drilling on all deep wells was held to a specified maximum depth; 20 ft. was selected as the distance which the driller would go after striking water. Casings had to be carried the entire depth of the well. It was not necessary to use well screens because the character of the aquifers was such that ordinary well casing, slotted with a cutting torch in the last two sections, proved very successful.

Military exigencies on the Guam operation did not permit the procurement of pumps on the basis of known capacities of wells. Instead, pumps, rated from 250 to 500 gpm., were ordered in advance of the actual recapture campaign. As a result, most of the pumps are oversized for the well capacities actually developed. Maximum well output proved to be about 300 gpm. with the average ranging from 150 to 200 gpm.

Although drawdowns from zero up to several feet have been experienced in new wells, capacities have been adjusted to prevent drawdowns from exceeding 18 in. Because of the small difference between specific gravities of fresh and salt water, an 18-in. drawdown at the lens surface ultimately results in a corresponding salt-water bulge rising up toward the point of drawdown a height of forty times the

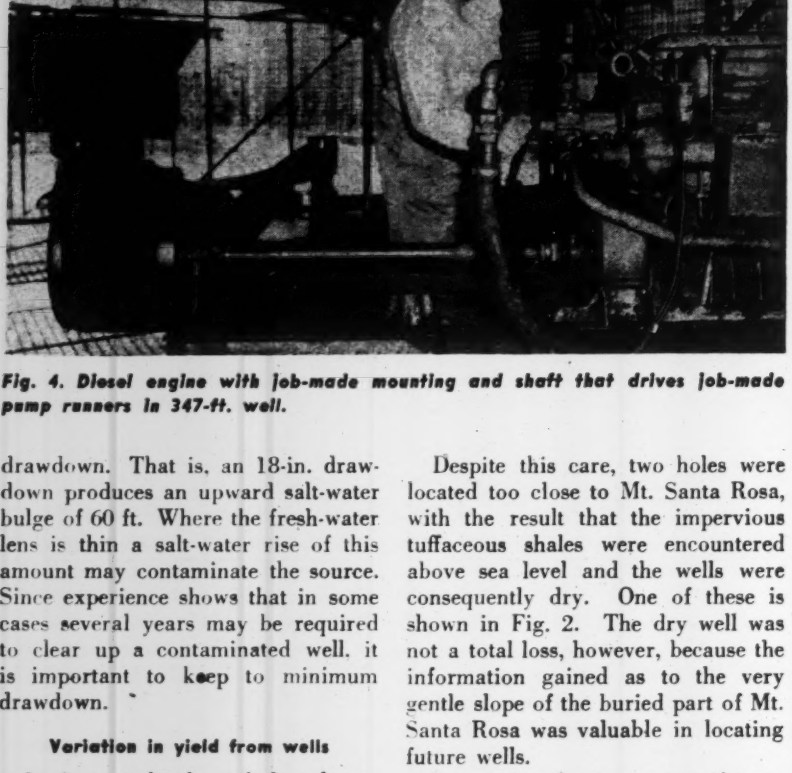


Fig. 4. Diesel engine with job-made mounting and shaft that drives job-made pump runners in 347-ft. well.

drawdown. That is, an 18-in. drawdown produces an upward salt-water bulge of 60 ft. Where the fresh-water lens is thin a salt-water rise of this amount may contaminate the source. Since experience shows that in some cases several years may be required to clear up a contaminated well. it is important to keep to minimum drawdown.

Variation in yield from wells

Static waterlevels and drawdowns in the wells were measured with an electric buzzer and a set of contacts on insulated, weighed wires arranged to be lowered into the wells. Some fifty-odd widely scattered wells used as measuring points revealed the approximate shape of the fresh-water lens and made it possible to select desirable locations for additional wells, preferably over the thicker sections of the lens.

Despite this care, two holes were located too close to Mt. Santa Rosa, with the result that the impervious tuffaceous shales were encountered above sea level and the wells were consequently dry. One of these is shown in Fig. 2. The dry well was not a total loss, however, because the information gained as to the very gentle slope of the buried part of Mt. Santa Rosa was valuable in locating future wells.

Except for the impervious formation underlying Mt. Santa Rosa, the fresh-water lens is general throughout the northern half of the island. Nevertheless, the yield that will be obtained from a new well cannot be predicted because of variations in porosity of the aquifer. The character changes greatly even in a few hundred feet. Two wells put down in exactly the same manner, with equal diameter and equal depth, produced 300 gpm. and 20 gpm, respectively.

While construction forces were awaiting the arrival of deep-well pumping equipment, several wells were drilled, capped and left idle. Some remained in this unused state for 3 or more months before pumps were put in. In most cases these wells proved to be poor producers, probably because pulverized coral remaining in the bottom of the drilled hole tended to solidify and hence to plug the aquifer.

In an endeavor to remedy this condition, these holes were sprung with about 100 sticks of 60 percent dynamite and then bailed out. While this procedure was partially successful in increasing productivity where the aquifer was hard and dense, it was wholly unsuccessful where the coral was impregnated with sand and clay.

Job-made deep-well pump

To meet the critical need for pumping equipment, one of the Seabees (Chief Machinist Mate Charles C. Roe, San Francisco) designed and built on the job a wholly satisfactory deep well pump for a 350-ft. well, which is now supplying water at a 300-gpm. rate to a nearby airfield.

Chief Roe's pump, typical of Seabee ingenuity, has a standard foot valve with a 6-in. opening and a rubber seat, designed and fabricated in the Seabee shop, which also turned out the 347 ft. of 1¼-in. shafting and rubber bearings. About 35 screws, similar to propellers for small boats, were placed at 10-ft. intervals along the shaft. This whole assembly, 347 ft. long, was then mounted inside a 6-in. thread-coupled pipe.

The thrust bearing in the pump head was salvaged from the nose of a wrecked P-38 plane. Pulleys were made from sections of well casing. Power was supplied by a reconditioned Gray marine diesel engine procured from the Piti Navy Yard. Heavy impregnated-canvas belting was obtained through a "deal" with an Army officer in charge of a nearby asphalt plant. Net result: One highly effective deep-well pump with diesel-engine drive and vertical shaft 347 ft. long producing 300 gpm. of fresh water—a worthy monument to Seabee "can-do" spirit.

Heavy demands for fresh water in densely populated areas of the island make it necessary to construct large basal groundwater stations. Each of

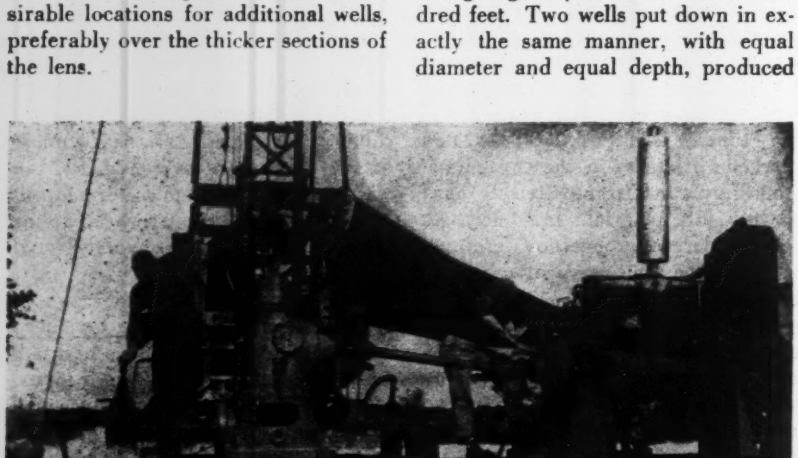


Fig. 5. Seabees installing a deep well pump in a 450-ft. hole. Cable tool drill rig in background.

these entails the driving of an inclined or vertical entrance tunnel down to the surface of the fresh-water lens, after which water tunnels, or drifts, 150 to 200 ft. long, are driven along the surface of the lens. Water from these tunnels is allowed to flow over a skimming weir into a concrete-lined sump, whence high-head, motor-driven centrifugal pumps deliver it to storage tanks.

Concrete sump and underground pumping station are located at the bottom of the inclined entrance tunnel. On the project currently under construction the entrance tunnel section is about 8 ft. square with an arched roof. The water tunnels are about 6 ft. wide and 8 ft. high, extending 2 ft. below water surface and 6 ft. above. Their roofs, like that of the entrance tunnel, are arched. The underground pump room, about 16x 30 ft. in plan, will house four 500-gpm., high-head centrifugal pumps. Stations of this type are expected to produce 2 to 3 mgd.

The skimming principle is one which has long been practiced in the Hawaiian Islands and lately by the Honolulu Board of Water Supply. Such wells are known there as Maui-type wells. (see *ENR* Mar. 25, 1937, vol. p. 450). On Guam the same method is being adapted to the particular problems encountered there. Obvious advantages are that only the very fresh water on the surface of the lens is skimmed off and only a very small drawdown results from large withdrawals, thus reducing to a minimum the hazard of salt contamination.

Jap mucking machine used

When confronted with the problem of driving several hundred feet of tunnel, Seabees scoured the island for any useful equipment. They made over a jeep into a "jeepmobile," manufactured muck cars to run on abandoned Jap rails and even discovered a small air-operated, Jap-built mucking machine used by the Nips in excavating their caves and underground fortification so typical of Japanese warfare.

A little skillful repair work put the mucker in operating condition. Like most Japanese equipment, it was a copy of a well-known American make, though on a vest-pocket scale. Because of the 30-deg. grade in the entrance tunnel, the small machine could not be used on this portion of the work and here the muck cars had to be loaded by hand. For loading muck in the horizontal drifts, however, the little mucker was worth its weight in gold.

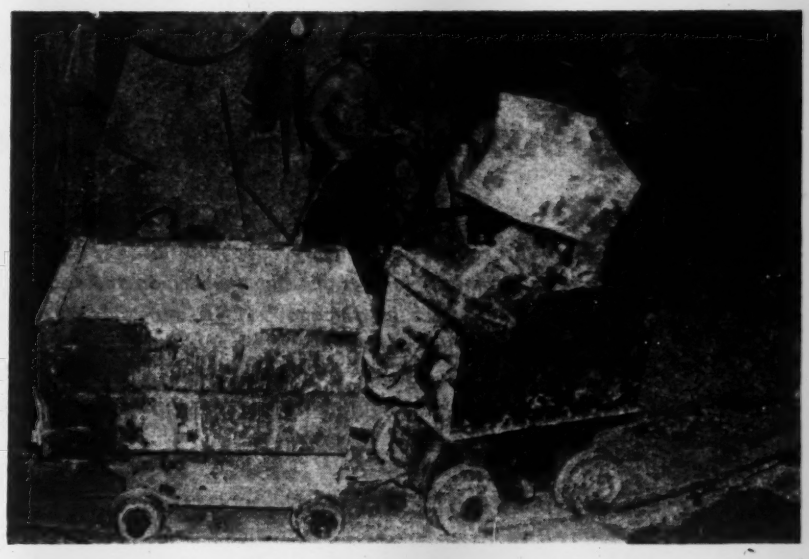


Fig. 6. Salvaged Jap mucker loading a muck car operated on rails used by Japs on airstrip construction.

Chlorides in the fresh-water lenses range from 942 down to 68 ppm. As some of the areas of higher chlorides are a considerable distance inland, it is believed that large crevices, or abnormal perviousness of the aquifer, in these areas permit a greater admixture of sea water with the recharging rain water than in other areas.

In checking the chlorides of the various groundwater supplies early in the development, testing kits were used in which the silver nitrate solution was more concentrated than that specified in instructions accompanying each kit. The result was the recording of chlorides much below the true values. For several months after these tests and before the error was discovered, several Seabee battalions as well as other personnel in one area drank water containing about two and one-half times as much chlorides as the U.S.P.H.S. potable water standard of 250 ppm. For more than 10 mo., and with absolutely no ill effects, one Seabee battalion has continued to use water containing more than 600-ppm. chlorides. The Island Sanitation Office, in conjunction with the naval medical research unit operating on Guam, has set an arbitrary limit of 650 ppm. in chlorides.

The logical conclusion from these experiences is that human taste from a potability standpoint is a satisfactory test for salinity. Certainly the human body can take, and in hot, tropical climates requires, a salt content several times the limit established by the U. S. Public Health Service standards for temperate zones.

Rainfall replenishment

Rainfall is the controlling factor in determining the safe limit for withdrawal of fresh water from the lenses. Naturally, if more water is removed than is replaced by rainfall, the supply will diminish. Rough calculations based on Guam's average annual rainfall reveal a potential supply of more than 25 mgd. from groundwater sources alone. This takes into consideration the fact that a large volume of water will be lost every day as fresh water flows into the sea from edges of the lenses.

Guam's average annual rainfall over a 19-yr. period was 87.45 in. More than 70 percent of this normally falls in the months of July, August, September, October and November. A close check on groundwater levels shows that they are gradually lowered during the dry months. In addition to this gradual lowering, there has been noted a slight but regular variation in the groundwater levels, not related to ocean tidal changes.

A second article by Lieut. Abplanalp on surface water development will appear shortly.

Questions and Answers on...

Repairing Chicago's Water Meters

***Editor's Note**—Several provocative comments and inquiries have been received from waterworks engineers throughout the country on the recent article, "Water Meter Shop Practice in Chicago," (ENR, May 31, vol. p. 778). In order to throw more light on the subject, the questions have been referred to W. W. DeBerard,, city engineer of Chicago, for further elaboration. Questions raised, together with Mr. DeBerard's replies, are presented.*

MORE DETAILS ON REBUSHING

In the Chicago method I cannot understand that portion under the subheading "Disc chambers are bushed." I think the trouble is all terminology, for example, where you say "This method consists of bushing the upper and lower ball sockets of each measuring chamber," does that not mean that new ball sockets are made and fastened into the old chambers? Also, where you speak of "gate pattern," does that not refer to the casting of the ball sockets and has nothing to do with the repair to the chambers themselves?—George W. Pracy, *superintendent, San Francisco Water Dept., San Francisco, Calif.*

ANSWER—Yes, we mean by "Disc chambers are bushed" that new ball sockets are installed in the old chambers. This rebushing is necessary due to the fact that there is excessive wear on the outlet side of the measuring chamber, especially in the lower half. The wear is so great that "grinding in of discs" is not possible and if the socket was not machined, the whole chamber would have to be discarded and a new one used.

Remachining of the sockets, however, results in a loss of metal and this weakens the chamber, hence it cannot be repeated and this is where the rebushing is effected. In Fig. I-a the chamber has been machined true and new socket is ready to be inserted (Fig. I-b). The old socket has been bored out with a radius tool to approximately $\frac{1}{4}$ in. larger than the standard required. The new socket or bushing is soldered in place (Fig. I-c). We built a special iron gas

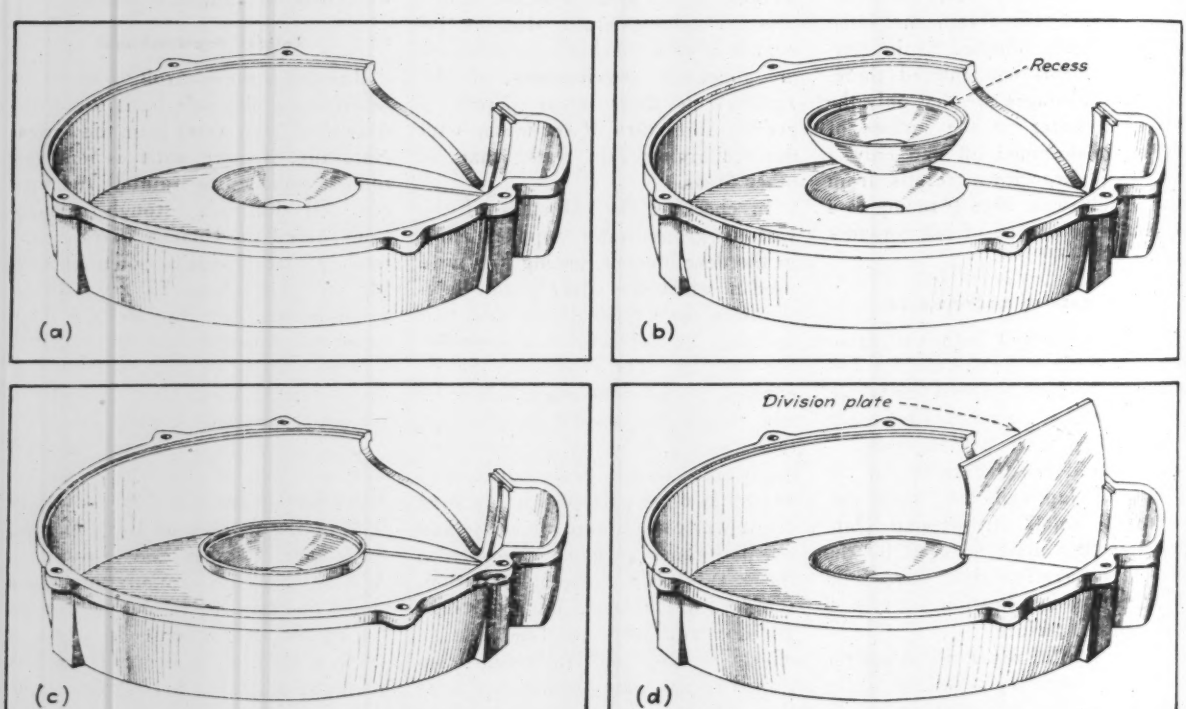


Fig. 1—Division board is removed and old socket is reamed to proper size (a). New bushing, recessed around its upper edge to provide chucking on a three-jaw chuck, is inserted (b), soldered in place (c), ground flush with the old disc chamber, machined to size and the division board replaced (d).

table with six Bunsen burners for heating this operation.

The next step is to turn the bushing to the proper size. We do this on lathes equipped with special fixtures that are screwed on the lathe spindle, similar to a chuck. The fixtures are equipped with plates which have a check that fits the checks on both the upper and lower halves of the measuring chamber. By turning a wheel on the shaft which extends through the hollow lathe spindle, the plate is pressed against the half-chamber and holds it secure. Then the socket can be turned to finished size after which the division plate is replaced (Fig. I-d).

This process of rebushing results in an indefinite life for a measuring chamber since in addition to the two or three times it can be used originally (once as standard size, plus once and possibly twice as machined oversize), each rebushed chamber can be used at least three times (undersize, standard and oversize). After the oversized bushing is worn, it can be removed, a new bushing installed and the process repeated over and over again.

Fig. II shows the type of gate pattern we have made for casting the various sized bushings or new sockets. We have about a dozen of these and refer to them by size and name. The accompanying table shows some bushing sizes we use on various sized meters.

We analyzed the material from a chamber of the meter we consider best and cast the bushings from this analysis. This metal consists of 86 percent copper, 7 percent tin, 5 percent lead and 2 percent zinc. From the dozen patterns we are able to obtain bushings which fit 40 different meters ranging in size from $\frac{3}{4}$ to 2-in.

TABLE OF GATE PATTERNS FOR DIFFERENT SIZED BUSHINGS

Upper Bushing	Lower Bushing
3/4-in. Badger Pattern Used On:	
3/4-in. Badger	3/4-in. Badger
3/4-in. Trident	3/4-in. Trident
3/4-in. Gamon	3/4-in. Gamon
3/4-in. Lambert	3/4-in. Lambert
3/4-in. Nash	5/8-in. American
5/8-in. American	5/8-in. Lambert
5/8-in. Lambert	
3/4-in. Worthington Pattern Used On:	
3/4-in. Wor. D & G	3/4-in. Wor. D & G
3/4-in. American	3/4-in. American
1-in. Gamon	1-in. Gamon
1-in. Trident	1-in. Trident
1-in. Federal Pattern Used On:	
1-in. Federal	1-in. Federal
1-in. Lambert	1-in. Lambert
3/4-in. Arctic	3/4-in. Arctic
1-in. Nash Pattern Used On:	
1-in. Nash	1-in. Nash
1-in. Wor. D & G. Pattern Used On:	
1-in. Wor. D & G	1-in. Wor. D & G
1-in. Arctic Pattern Used On:	
1-in. Arctic	1-in. Arctic
1-in. American	1-in. American
1 1/2-in. Wor. D	1 1/2-in. Wor. D
1 1/2-in. Gamon	1 1/2-in. Gamon
1 1/2-in. Badger (new style)	1 1/2-in. Badger (new style)
2-in. Nash	2-in. Nash
1 1/2-in. Lambert Pattern Used On:	
1 1/2-in. Lambert	1 1/2-in. Lambert
1 1/2-in. Federal	1 1/2-in. Federal
1 1/2-in. Badger (old style)	1 1/2-in. Badger (old style)
2-in. Lambert Pattern Used On:	
2-in. Lambert	2-in. Lambert
2-in. Gamon	2-in. Gamon
1 1/2-in. Wor. D & G	1 1/2-in. Wor. D & G
1 1/2-in. American	1 1/2-in. American
2-in. Wor. D & G Pattern Used On:	
2-in. Wor. D & G	2-in. Wor. D & G
2-in. Arctic	2-in. Arctic

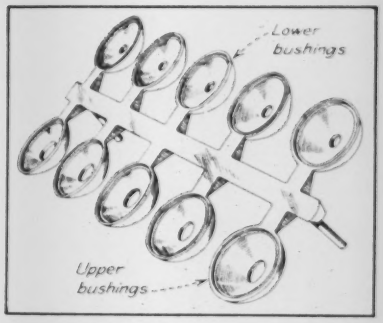


Fig. 2. Bushings for upper and lower ball sockets are cast in gate patterns of various sizes.

SILENCING NOISY METERS

We are especially interested in the statements with regard to silencing noisy meters. We might attempt something of this kind but the description and pictures do not make it quite clear to us as to some of the details.

We think we have the general idea, but are a little doubtful about making the rubber strips stay put in the places they are supposed to go.—D. D. Gross, *chief engineer, Board of Water Commissioners, Denver, Colo.*

ANSWER—In quieting noisy meters, we treat the conical disc and the flat one differently. With the conical, we found the noise was due to the edge of the disc slot striking the diaphragm or division plate, after the balls and sockets had become worn. To rectify this we have inserted pieces of gum rubber $\frac{1}{8}$-in. thick into the edge of the slot. Small pins or brass screws countersunk into the rubber insert hold it in place perfectly (Fig. III-a), and we have never had a case of one coming loose. The resulting action seems to be like that of a windshield wiper on an automobile and the pounding due to the edge of the slot striking the division plate is eliminated.

With the flat disc, we use the same idea but insert the rubber into a groove cut in that edge of the disc slot which strikes the division plate at the outlet port of the measuring chamber. In addition to this we cut a slot on both top and bottom faces of the disc, $\frac{1}{4}$-in. from the outside edge and extending completely around its circumference (Fig. IV-a). On the inlet side of the disc opening these slots on the two faces are connected by drilling a 3/16-in. hole. On the outlet side the slots are terminated by turning them toward the center of the disc about $\frac{3}{4}$ in.

These slots or grooves in the disc faces are made in two steps (Fig. IV-c and IV-d). In step No. 1 the slot is

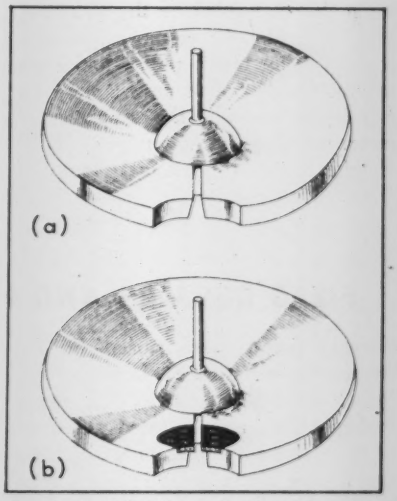
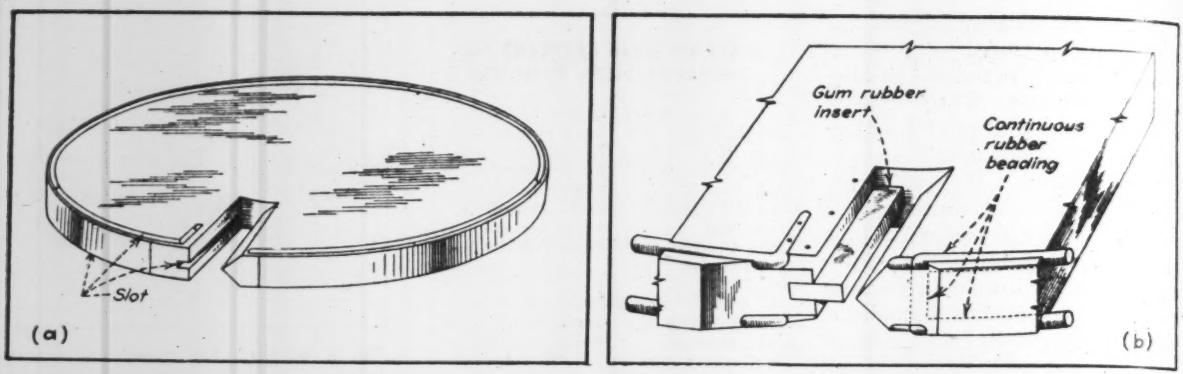


Fig. 3. Conical discs of noisy old meters (a) are silenced by inserting a 1/8-in. thick gum rubber pad held in place by small metal screws or pins (b).



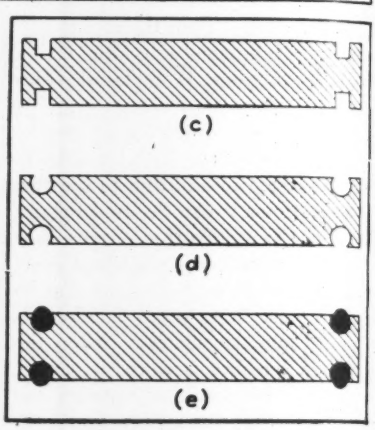


Fig. 4. Noisy flat discs are slotted top and bottom around their circumference and along one edge of the disc slot (a), a continuous length of rubber beading then is inserted in the circumferential slots and a gum rubber insert is pinned in place (b). Operations required to insert beading, shown in Section A-A, include cutting initial rectangular slots (c), enlarging them to correct size with a forming tool (d) and inserting rubber beading (d).

turned to a width equal to 1/32 in. less than the diameter of beading to be inserted in it and to a depth equal to one-half the diameter of the beading. In step No. 2 the slot is undercut with a forming tool to the diameter of the beading.

Next, a continuous length of rubber beading is inserted in these circumferential grooves. One end is pinned on top, run around the disc, through the 3/16-in. hole provided at the inlet side of the disc, then around the bottom face of the disc and pinned near the outlet port (Fig. IV-b). Finally, the inside edge of the disc slot is faced off to a point as shown in the pictures.

We trim the contact roller about 1/64 in. on flat discs after the above operations in order to avoid excessive pressure on the disc spindle, but do not find it necessary to do this trimming on conical ones. We do not find the accuracy of the meters so processed, affected at all.

ACCURACY OF REMOVED METERS

I think the Chicago article on meter repair is very much the kind of thing that is needed by the industry. I would make the comment though, that no meter repair policy had been adequately described until a showing has been made of the accuracy of meters coming out of service.—M. P. Hatcher, *director, Department of Water, Kansas City, Mo.*

ANSWER — For many years Chicago tested the accuracy of each meter as it was taken out of service for repairs, but the practice was discontinued some 20 years ago. Our experience indicates that when a meter is run beyond the capacity indicated it is ready for overhauling and the time and money spent in testing it as it comes into the shop, is wasted.

FIELD REPAIRS AND HOT WATER DAMAGE

Several points were raised in one letter received from St. Louis, as follows: Chicago's practice of using rather highly concentrated solutions of nitric and sulphuric acids for cleaning bronze meter parts involves very careful handling of parts if they are not to be damaged. The use of more dilute solutions or certain recently developed inhibited acid cleaners might be more acceptable. Fig. 4, vol. p. 780 showing the acid jars does not indicate whether they are beneath a fume hood. Also, the jars are entirely exposed and might be broken. Should this happen the acid contents might spill upon a workman. With the volume of work handled in the Chicago meter repair shops it would seem that a considerably more elaborate cleaning layout would be warranted.

The requirement that the property owner install proper valves to prevent hot water or steam backing up into a water meter is a very effective way to prevent the recurrence of warped discs from hot water and it is a practice not in general use. A more explicit description of the temperature control and pressure relief valve installation might be of interest to readers of the article.

The article indicates that field crews undertake the repair of meters in the field before a faulty meter is brought into the shop. Inasmuch as small meters, 2-in. and smaller, can be changed easily it would appear questionable practice to undertake the repair of such meters in the field, particularly since testing for accuracy is difficult in the field and the expense of a three-man crew repairing a small meter would be out of proportion to the cost of making repairs in the shop.

The work of the Chicago meter shops is complicated, as in many others, by the fact that many makes of meters must be repaired. The article mentions 40 different meters ranging in size from $\frac{3}{4}$ to 2 in. It seems to me that standardization, as practiced by many utilities, both municipal and private would greatly lessen

and simplify these shop procedures.

I was particularly interested in the methods used to silence noisy meters, and the steps taken by Chicago to silence them are unique and commendable. Certain questions arise regarding the insertion of gum rubber strips on the faces of flat discs to keep them from contacting the measuring chamber. Is it necessary to trim the contact roller or control block to prevent excessive pressure from the disc spindle? Moreover, is meter accuracy at low flows affected by increasing the clearance between the disc and the measuring chamber, allowing clear, through waterways between the disc and the chamber?

My final comment would be that the operating personnel of the Chicago Meter Division appears to be completely in step with the advanced practices of the other divisions of the Chicago Water Department. Maintaining meters in Chicago is certainly "big business," and is being handled in a business-like way.—M. Victor Weir, *superintendent, St. Louis County Water Company, University City, St. Louis, Mo.*

ANSWER— The acid treatment we use is advocated by several meter manufacturers and in no way damages any part of the meter. We have tried nearly every cleaning compound on the market and none does the job as efficiently as the acid method. Although Fig. 4 does not show it, we do have a fume hood over the jars. Moreover, the jars are inspected periodically to determine their condition. We have never broken one in all the years we have been using the acid bath and feel it highly improbable that we ever will. However, in the interest of safety, we are building an enclosure for the jars that will safeguard the workman against this possibility even though it is very remote.

The valve installed to prevent the warping of discs from exposure to hot water or steam is an approved lever-handle automatic type reseating temperature and pressure relief valve, with a fusible plug. It operates at 200 deg. F. and 75 psi. It is installed in the top of the tank or unit, or not more than 3 in. from the tank or unit in the hot water line. We also insist that the relief valve shall not be less than one pipe size smaller than the water supply pipe to the tank and no valve shall be placed between it and the tank or unit. Several manufacturers make this type of relief valve and they can be purchased from most plumbing supply houses.

Our crews made over 10,000 repair jobs in the field during 1943, and these were of a varied, though minor nature. Such work as repairing spindle leaks, replacing corroded counters, replacing broken glass or lids, and remeshing gears can, we believe, be done much more economically on the spot, than if each meter in question was arbitrarily replaced with a substitute, brought into the shop, inspected and repaired there.

We agree with Mr. Weir that we could operate our shop more economically if only one or two makes of meters were used. However, we must buy the meters from the lowest bidder, and hence cannot control this phase of operation.

Yes, it is necessary to trim the contact roller about 1/64 in. on flat discs, but none is necessary on the conical shaped discs. Numerous tests have proved meter accuracy was not affected at all by disc alterations.

COST OF METER REPAIRS

My first impression on reading the article on Chicago's methods of repairing water meters is that a very thorough job is being done, but I wonder what it costs for the different sized meters. From figures given in the article, 15,000 meters were repaired at a cost of $0.0095 per thousand cubic feet; total registration amounted to 22.5 billion cubic feet. This shows an average cost of $14.25 per meter. This cost seems quite high considering the large percentage of meters that are 1-in. and smaller. I would like to know what percentage of meters repaired were the small ones.—Thomas J. Skinker, *water commissioner, St. Louis, Mo.*

ANSWER — Of Chicago's 115,000 meters in service 97,000 are 1-in. and smaller—hence the percentage of these is 84.3. Of the 15,000 meters repaired during 1943, 24 per cent were 1½-in. and larger while 76 percent were 1-in. and smaller.

Considering the fact that the average registration of each meter in Chicago is 196,000 cu. ft. per year, and therefore our meters are subjected to more than ordinary wear; that the rehabilitation job we do results in making each meter as good or better than it was when it was brand new; that each operation is cheaper than buying new parts and installing them; and that we have the advantage of always being able to repair meters without any delay, we consider the cost very moderate.

More States Authorize Municipalities To Establish Postwar Funds

Municipalities of more than half the states are authorized to set up post-war reserve funds as a result of action taken by six legislatures during current sessions, according to the Municipal Finance Officers Association.

States which have recently authorized municipalities to set aside funds for postwar construction and repair of public works include: Montana, South Dakota, Utah, Idaho and Nevada. Washington permitted counties to build up postwar reserve funds.

The 21 states which previously gave municipalities authority to establish postwar reserves include: Arizona, Connecticut, Florida, Maine, Maryland, Minnesota, New Hampshire, North Carolina, North Dakota, Oregon, Pennsylvania, Rhode Island, West Virginia, Kentucky, Massachusetts, New Jersey, California, Michigan, New York, Washington, and Nebraska.

Major sources of reserve funds are budgetary appropriations supported by annual tax levies, and unencumbered balances of the general fund. Statutes usually specify the maximum amount of any special annual levy, and in Nebraska and North Dakota the special levy is limited to 10 years and two years respectively.

Book Notes and Reviews

The month's addition to the engineer's reading and reference list

For the Practicing Engineer

AN INTRODUCTION TO SOIL MECHANICS—By W. L. Lowe-Brown, 56 pp. Sir Isaac Pitman & Sons, London; Pitman Publishing Co., New York 19. $1.75.

This little book, according to the author, has been prepared to aid the practicing engineers who "long ago laid aside their mathematics for more urgent matters" and who are deterred from attempting to learn something about soil mechanics by the fact that most articles and texts on the subject "bristle with formulae and mathematical operations". Finding himself in that condition and with time to do some reading, Mr. Lowe-Brown reviewed the current material on soil mechanics and prepared this descriptive survey, written in simple language, to aid his fellows. The main part of what he wrote appeared originally in *The Engineer*, London, some two years ago. Its publication in book form was delayed by the war.

Track and Switch Work

TRACK AND TURNOUT ENGINEERING—Third Edition, by C. M. Kurtz. 461 pp. Simmons-Boardman Publishing Co., New York. $5.

The new feature in this third edition of Mr. Kurtz's book is an improved method for handling the always difficult task of staking out turnouts to divergent tracks from a curved track. For railroad men not familiar with the book it should be added that while not called a pocketbook this is a book that can be slipped in a side pocket. It is packed full of information that railroad engineers need in the field.

Piping Book Revised

PIPING HANDBOOK—4th Edition, by Sabin Crocker. 1,376 pp. McGraw-Hill Book Co., New York 18 and London. $7.

The fourth edition of this handbook, first published in 1930, brings piping developments up to date by including new chapters on piping for gas, refrigeration and hydraulic power transmission, as well as on corrosion. The last also covers the subject of protective coatings. In addition, the chapter on water supply piping has been considerably augmented and supplementary material has been added to the section on flow of water in pipes.

Abstracts of new codes, dimensional standards and materials specifications for piping have been added, and those appearing in earlier editions have been revised to bring them up to date. Improved tables and charts are provided, as are additional authority citations and cross references.

Mosquito Fighter's Handbook

THE MOSQUITOS OF NORTH AMERICA—Second Edition, revised and amplified, by Robert Matheson. 314 pp. Comstock Publishing Co., Ithaca, N. Y. $4.

Identification of mosquitos as to species is the first step in setting up control measures. A complete and authoritative guide to this end, with which is included much informative material on the anatomy and biology of mosquitos, is furnished by Professor Matheson's book. Its conciseness should specially appeal to sanitary engineers and public health workers.

While the book makes no pretense to being a complete treatise on all phases of mosquitos, it does nevertheless include chapters on such practical matters as control methods, study and collection of specimens and the relation of mosquitos of various types to disease transmission.

Blueprint Reading

BUILDING TRADES BLUEPRINT READING—By J. Ralph Dalzell. American Technical Society, Chicago, Ill. Part I—Fundamentals, 142 pp. $2. Part II—Specifications, Blueprints and Examinations, 92 pp. $2.

Contending that the skills, knowledge and techniques needed to make an architectural drawing are not necessary in order that a student may learn to read and interpret that same drawing, the author approaches the subject of blueprint reading in a manner different from many of the older texts. Consequently, the book deals only with development of the necessary skill in visualization plus a thorough understanding of the symbols that commonly appear on blueprints.

Elementary Steel Design

CONSTRUCTION STEELWORK SIMPLY EXPLAINED—Second Edition, by Oscar Faber. 128 pp. Oxford University Press, London and New York. $2.

Since the first edition appeared, a code of practice for the design of steel structures was published by the Steel Structures Research Committee of the British Department of Scientific and Industrial Research, having the effect of increasing working stresses in beams from 7½ to 8 tons per sq. in. and allowing increased stresses in columns. Although the basic principles of design remain unchanged, the work has been revised to account for these changes. It still remains a simple introduction to the design of steelwork.

Reports and Pamphlets

SUBMERGED SHIPWAYS—An account of pioneer engineering and construction of two horizontal shipways of unique design at Newport News, Va., 1940-1942. Dravo Corporation, Pittsburgh, Pa.

SCIENCE THE ENDLESS FRONTIER—By Vannevar Bush. A report to the President on a program for postwar scientific research. U. S. Government Printing Office Washington, D. C.

TIMBER IN BRAZIL—Brazilian Government Trade Bureau, 551 Fifth Ave., New York 17.

TENTATIVE MAJOR STREET PLAN—Toledo-Lucas County Planning Commissions. Published by the Commission of Publicity and Efficiency, Toledo, Ohio.

THE 1944 LAWS BULLETIN—A Digest of New Legislation Affecting Highway Users Conference, National Press Building, Washington, D. C.

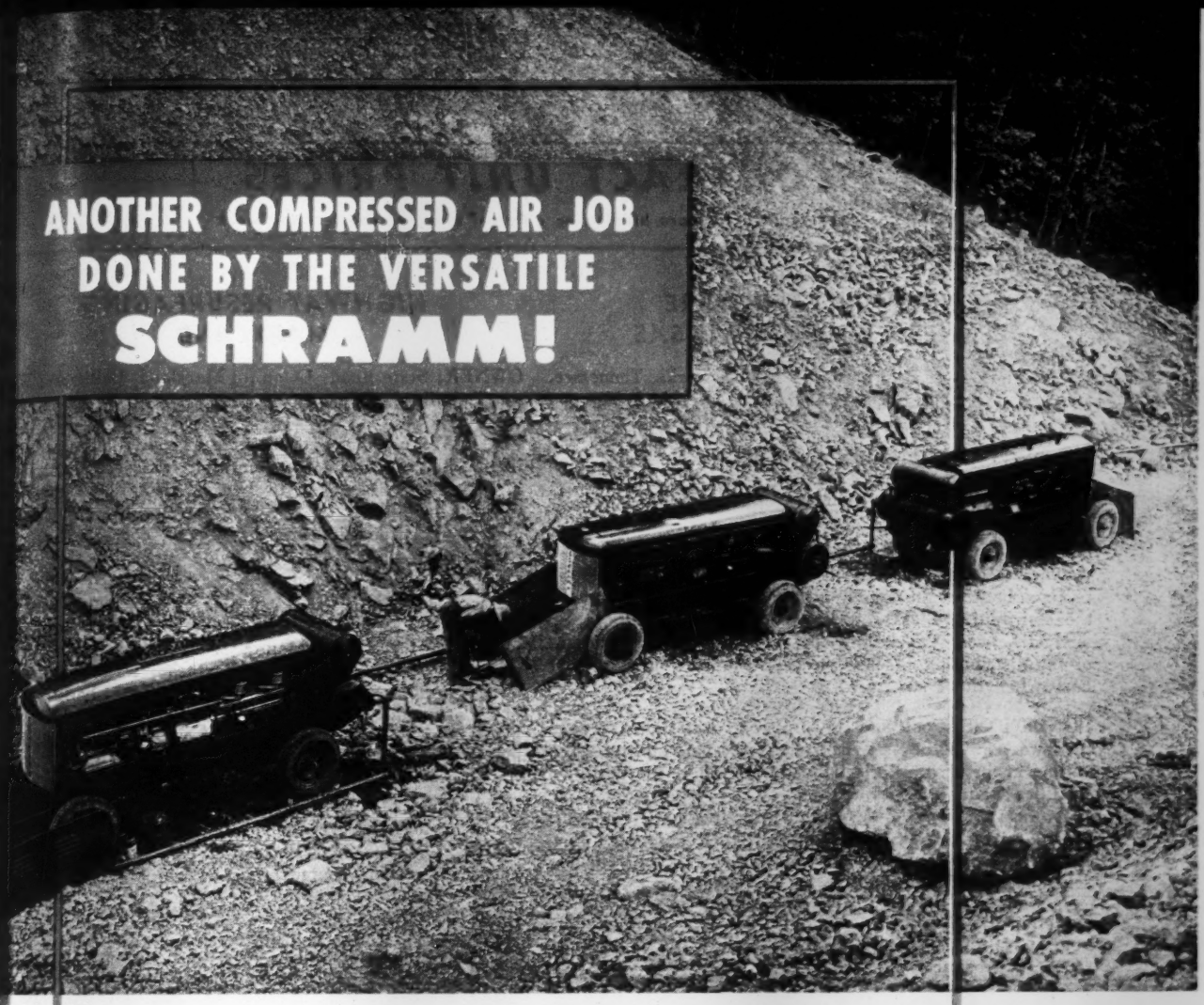
PLANNING NEIGHBORHOOD SHOPPING CENTERS—By Marcel Villanneva. National Committee on Housing, Inc., 512 Fifth Ave., New York 18. $1.

SURVEY AND DIRECTORY MARKETING RESEARCH AGENCIES IN THE UNITED STATES—By Ernest S. Bradford. City College Bureau of Business Research, New York.

CONFERENCE REPORT ON NEW DEVELOPMENTS IN WOOD PRODUCTS—The New York State College of Forestry, Syracuse University, Syracuse, N. Y.

ABSTRACTS OF EARTHQUAKE REPORTS FOR THE PACIFIC COAST AND THE WESTERN MOUNTAIN REGION—April, May, June, 1944. Issued by the U. S. Coast and Geodetic Survey, Washington, D. C.

(*Continued on p.* 150)



You can bet this construction job needed plenty of compressed air for rock excavation . . . and promptly Schramm Air Compressors were pulled onto the job!

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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

BRIDGE SUBSTRUCTURE TENNESSEE AND ARKANSAS

OWNER: Dept of Highways and Public Works, Tennessee, and Arkansas State Highway Comm.; Modjeskie & Masters, Harrisburg, Pa., consulting engineers.

PROJECT: Main bridge substructure of highway bridge across the Mississippi River between Memphis, Tenn., and Crittenden County, Ark. (Part I). Involves construction of the Memphis abutment and the seven main piers of the bridge. Alternates were allowed on the placing of the mass volume of concrete in Piers 5, 6 and 7, either by pneumatic process, between the founding elevation and the bottoms of the distributing blocks, or by open dredge, tremie sealed method between the cutting edge elevation and the bottoms of the distributing blocks. Award was made on the latter basis. Length of structure 3,695 ft.

CONDITIONS: Contractor to furnish all materials and complete work in 760 days. Wage rates to be paid are those prevailing in the area. Rail, highway and water transportation facilities available to project site.

BIDS: Five bids were received July 18, 1945, ranging from the contract low of $4,333,174 to $7,438,930. Bid opening scheduled for February 28, 1945 was postponed.

LIST OF BIDDERS:

1. Merritt-Chapman & Scott Corp., New York, N. Y. (contract) $4,333,174
2. Kansas City Bridge Co. and Massman Constr. Co., Kansas City, Mo. 4,369,960
3. Dravo Corporation, Pittsburgh, Pa. 4,633,710
4. Four Companies, Inc., Boston, Mass. 5,393,642
5. Missouri Valley Bridge Co., Morrison-Knudsen Co., Winston Bros. Co., Leavenworth, Kan. 7,438,930

Item	Quan:	Unit Prices (1)	(2)	(3)
1. Underwater fill, Pier 1	Lump Sum	$41,795.00	$18,000.00	$36,000.00
2. Willow mattress—Piers 1, 2 and 3	2,450 sq.	66.60	50.00	70.00
3. Stone for mattress	1,900 c. y.	8.20	10.00	12.00
4. Heavy riprap for mattress	18,000 c. y.	8.85	8.00	8.00
5. Riprap paving	400 sq.	72.00	44.00	40.00
6. Piles in place, Memphis abutment	5,640 l. f.	5.20	3.25	3.00
7. Concrete in footing, Memphis abutment	445 c. y.	28.80	20.00	30.00
8. Stone masonry facing, Memphis abutment	2,800 c. f.	6.25	6.30	10.00
9. Conc. behind facing, Memphis abutment	430 c. y.	52.00	31.50	36.00
10. Mass volume in Pier 1, between founding elev. and bottom of distributing block	4,970 c. y.	45.00	54.50	65.00
11. Mass volume in Piers 2, 3 and 4, between founding elev. and bottoms of distributing blocks	25,200 c. y.	59.20	68.00	73.00
12. Mass volume in Piers 5, 6 and 7, pneumatic process, between founding elev. and bottoms of distributing blocks	21,700 c. y.	.....	34.00	37.00
13. (Alt. for Item 12) Mass volume in Piers 5, 6 and 7, open dredge, tremie sealed, between C. E. elev. and bottoms of distributing blocks.	23,800 c. y.	37.20	.....	32.00
14. Concrete in distributing blocks, Piers 1 to 7, incl.	3,300 c. y.	18.40	15.50	20.00
15. Stone facing, Piers 1 to 7, incl.	163,000 c. f.	4.80	4.90	4.70
16. Conc. behind facing, Piers 1 to 7, incl.	23,400 c. y.	13.60	15.00	15.00
17. Reinforcing steel, in place	371,000 lb.	.115	.08	.08
18. Structural metalwork and anchor bolts in place	251,000 lb.	.15	.15	.13

HIGHWAY RESURFACING MARYLAND

OWNER: State Roads Comn. of Maryland, Baltimore; Wil[l]son T. Ballard, chief engineer.

PROJECT: Asphaltic concrete resurfacing Baltimore-Wash[ington] Boulevard from a point four miles south of Dea[d] Man's Curve Relocatoin to Laurel, Howard County, Md[.] Consists of placing 2½-in. asphaltic concrete base cours[e] and 1½-in. asphaltic concrete wearing course on existing roadway approximately 40-ft. wide for a length of four miles.

CONDITIONS: Contractor to furnish all materials and complete project in 110 working days. Rail and highway transportation facilities available. Very heavy traffic to be maintained, therefore, surfacing is to be placed in half sections. Minimum wage rates specified are: skilled labor, 70c. per hour; semi-skilled, 55c. per hour; and common, 40c. per hour.

BIDS: Three bids were received May 15, 1945 ranging fro[m] $158,790 to $162,289 (using slag in base and wearing courses); and from $171,786 to $175,969 (using stone in base and wearing courses).

LIST OF BIDDERS:

1. American Paving & Cont'g. Co., Baltimore, Md. (Low Bidder) ..... (Slag) $158,79[0]
   (Stone) 171,7[86]
2. T. B. Gatch & Sons, Inc., Baltimore, Md. ..... (Slag) 162,[289]
   (Stone) 175,4[69]
3. E. Stewart Mitchell, Baltimore, Md. ..... (Slag) 162,2[89]
   (Stone) 175,9[69]

Item	Quan:	Unit Prices (1)	(2)	(3)
1 Class 1 excavation	3,000 c. y.	$1.25	$1.00	$1.[25]
2. Class 2 excavation	1,300 c. y.	1.50	1.50	1.[75]
3. Borrow excavation	300 c. y.	1.00	1.00	[2]5
4. Tamped fill	150 c. y.	1.00	1.00	1.[25]
5. Remove exist. concrete pavement (shoulder area)	100 s. y.	1.50	1.00	1.[00]
6. Remove existing masonry	15 c. y.	10.00	7.50	5.[00]
7. Calcium chloride	18 ton	45.00	40.00	40.[00]
8. Sub-base, Type 2	600 c. y.	1.75	1.50	2.[50]
9. Penetr. macadam base course	600 ton	4.00	3.50	3.[00]
10. Bitum. mat'l. for penetr. macadam base course	4,350 gal.	.13	.11	.[09]
11. Gravel surf. course for shoulder stabilization	16,200 s. y.	.45	.55	.[45]
12. Asphaltic conc. wear. course, Spec. B, using stone	9,700 ton	5.70	5.84	[6].00
13. Asph. conc. wear. crse., Spec. B, using slag	8,730 ton	5.70	5.84	6.[00]
14. Asp. conc. base crse., Spec. B, using stone	13,100 ton	5.70	5.84	6.[00]
15. Asph. conc. base crse., Spec. B, using slag	11,790 ton	5.70	5.84	6.[00]
16. Bitum. mat'l. for tack coat	15,800 gal.	.12	.11	.[12]
17. 6-in. pipe underdrain outlets	100 l. f.	1.00	.50	.[50]
18. 10-in. pipe underdrain outlets	70 l. f.	1.20	1.00	1.[20]
19. 6-in. perf. pipe underdrain	3,200 l. f.	.60	.45	.[50]
20. 10- in. perf. pipe underdrain	1,400 l. f.	.90	.80	1.[00]
21. 15- n. pipe	6 l. f.	2.50	2.00	2.[00]
22. 18-in. pipe	238 l. f.	2.75	2.50	2.[50]
23. 30-in. pipe	4 l. f.	5.00	10.00	8.[00]
24. 6x18-in. rein. conc. wye branch	1 ea.	30.00	20.00	25.[00]
25. Cl. A. conc. pipe endwalls	8 c. y.	40.00	45.00	45.[00]
26. Cl A. concrete using regular cement	15 c. y.	40.00	45.00	45.[00]
27. Reinforcing steel bars	1,350 lb.	.10	.08	.[08]
28. Aggregate bkfill. for underdrain	1,040 c. y	3.40	3.50	3.[50]
29. Drilled holes	30 l. f.	2.00	2.00	3.[00]
30. Portland cem. conc. gutter, 5-in. (Cl. A conc., reg. cement)	100 s. y.	2.70	3.25	3.[50]
31. As above, 8-in.	100 s. y.	3.60	3.50	4.[00]
32. Patch 9-in. conc. pavmt. (Cl. X early strength cement)	2,000 c. y.	4.50	4.50	4.[50]
33. Maintenance of traffic	Lump Sum	3,000.00	4,000.00	1,500.[00]

A Tocco induction heat-treating machine for hardening track shoe pins in the Oliver "Cletrac" plant.

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MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

CONSTRUCTION MATERIAL prices and labor rates reported to *Engineering News-Record* for September record only slight changes from the preceding month's quotations. Paving brick is $2.00 per M higher in Kansas City and common brick is up $3.50 per M there. Minneapolis reports an increase of $4.00 per M for straight hard selected common brick. Lime prices are lower in Montreal.

Lumber, iron and steel products, cement, aggregate, concrete block, ready-mixed concrete, paving asphalt, structural clay building tile, and paint and roofing supplies are unchanged from a month ago. Railway ties are up in Chicago, and vitrified sewer pipe is higher in New York.

The carpenters' rate rose from $1.775 to $1.85 per hour in Chicago, the only change in skilled labor rates reported for September. In Denver, both common labor on buildings and common labor on heavy construction are 2½c. per hour higher than last month. As a result of these wage rate increases, the *ENR* Skilled Labor Average rate rose to $1.670 per hour, and *ENR* Common Average increased to $0.917.

CEMENT, AGGREGATE, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., C/L lots, incl. 40c. per bbl. for bags, cash dis. not deducted)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE BLOCK 8x8x16-in.; truckload del.; per block		READY MIXED CONCRETE 1:2:4, over c.y., del
	Cloth [a]	Paper	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in	¾ in.	1½ in.	¾ in.	Sand-grav.	Lt.wgt. Agg.	50 c.y., del
Atlanta	$2.77	$2.52	$2.47	$1.79	$1.89	$1.99	$1.79	$1.89	$1.59	$1.69	$0.17	....	$8.30
Baltimore	2.62	2.37	2.12	1.80‡	1.80‡	1.30‡	1.80‡	1.80‡	1.75‡	1.75‡	.125	$0.125*w*	7.45
Birmingham	2.50	2.25	2.10	1.75	1.75	1.50	.85	1.00	.90	1.15	.1425	....	5.80
Boston	2.97*b*	2.72*b*	2.52	1.50‡	1.50‡	1.05‡	1.25‡	1.35‡	....	....	.13	.155*w*	7.55*m*
Chicago	2.90	2.65	2.50	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	1.75‡	1.75‡	.18	.18*x*	....
Cincinnati	2.41	2.16	1.96	1.20	1.20	1.10	1.80	1.80	....	....	.12	.15*w*	6.70
Cleveland	2.49	2.24	....	1.75*i*	1.75*i*	1.25/1.65*i*	1.80*i*	1.80*i*	1.15	1.15	.14	.14	7.45
Dallas	2.51	2.26	2.06	1.50*p*	1.70*p*	1.10*p*	1.69*p*	1.79*p*	....	....	.15	....	7.15
Denver	3.32	2.72	2.47	1.20	1.30	1.25	1.65	1.75	1.00	1.00	.15	....	7.25
Detroit	2.49	2.24	2.09	1.50	1.50	1.30	2.25	2.25	2.00‡	2.00‡	.13	.14*w*	7.15
Kansas City	2.58	2.33	2.18	1.85	2.30	1.00	1.91	1.91	....	....	.125	.125*wy*	7.50*n*
Los Angeles	3.20*v*	2.60*v*	....	1.30	1.30	1.15	1.30*f*	1.30*f*	....	....	.04*bb*	.10*aa*	7.25
Minneapolis	3.07	2.82	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	.14	....	7.55*j*
Montreal	....	1.95*r*	1.79*r*	1.65‡*s*	1.65‡*s*	1.50*t*	.80*ct*	.90*ct*	....	....	.14*t*	.14*wt*	7.85*la*
New Orleans	2.41	2.16	1.92	1.67	1.65	1.22	....	....	.90	1.15	.19	....	9.25
New York	2.85‡	2.60‡	....	1.60*de*	1.60*de*	.90*d*	1.70*de*	1.80*de*	....	....	.16	.14*wcc*	8.25*k*
Philadelphia	2.73	2.48	2.28	1.55‡	1.65‡	1.20‡	1.90	1.95	1.10	1.10	.155	.155*w*	8.45
Pittsburgh	2.70	2.45	2.25	1.65‡	1.65‡	1.85‡	2.25‡	2.25‡	1.50	1.50	.17	.17*s*	8.40
St. Louis	3.00	2.72	....	1.75‡	1.40‡	1.25/1.40‡	1.25*h*	1.25*h*	.90*g*	1.10*g*	.145	.12*w*	8.60
San Francisco	2.21	2.01	1.71	1.36	1.36	1.36	1.46	1.46	....	....	....	.21*y*	7.55
Seattle	....*u*	3.00*o*	....	2.35d‡	2.35d‡	2.35d‡	2.85‡*od*	2.85‡*od*	....	....	.16	.16*y*	7.25

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* F.o.b. quarry. *d* Per cu. yd. *e* Barge lots alongside docks. *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount of 2 percent for cash in 10 days. *l* Up to 200 cu. yd. *m* 50c off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days. *r* 10c. per bbl. off, cash 20 days. *s* 8% sales tax included. *t* 8% sales tax not included. *u* Withdrawn. *v* 20c. per bbl. discount; 20c. allowed for returnable cloth bag. *w* Cinder. *x* Waylite. *y* Haydite. *z* Celocrete. *aa* Pumice. *bb* 4 x 8 x 12 in. *cc* Also 8 x 18 x 18 in.

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice. Subject discount 10c. per bbl 20 days in Montreal.

CURRENT MAXIMUM PRICE BASES AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind	$1.90	$1.85	Ironton, Ohio	$1.70	$1.65	Richard City, Tenn.	$1.80	$1.75
Dallas, Tex	....	....	Limedale, Ind	....	....	Steelton, Minn	2.00	1.95
Hannibal, Mo	1.90	1.85	Norfolk, Va	....	....	Universal, Pa	1.75	1.70
Hudson, N. Y	....	....	Northampton, Pa	1.75	1.70	Waco, Tex. (Plus 9c. tax in Tex.)	1.75	1.70
Independence, Kans	1.70	1.65	North Birmingham, Ala	....	....	Montreal City (Discount 10c. per bbl. 20 days)	1.68	1.67

PAVING BRICK, BLOCK, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICK AND BLOCK			PAVING ASPHALT (Per ton, less than 80 penetration)		ASPHALT BINDERS—FLUXES (Per gal., 80–300 penetration)		CUTBACK ASPHALT (Per ton)		ROAD OIL (Per gal)	ASPHALT EMULSION (Quick-breaking) (Per gal)	
	Granite per M lots of 50,000 4x4x8 in.	Brick per M 3x4x8½ in carload lots	Wood per sq. 6d. 3½ in 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$73.00	$39.35	$2.25	$18.53*e*	.....†	$0.0740*e*	.....†	$0.0806*he*	.....†	$0.0781*e*	$0.0806	.....†
Baltimore	150.00‡	49.00	85.00*m*	15.00*r*	21.00*r*	.06*r*	.09*r*	13.00*r*	23.00*r*	.06*r*	.07*r*	.14*r*
Birmingham	150.00	32.00*j*	.....	17.95	.....†	.0747	.....†	.0834*h*	.....†	.065	.095	.....†
Boston	85.00	59.00	3.75	15.00	24.00	.0625	.115	17.00	30.00	.0625	.0825	.145
Chicago	150.00	55.00	2.50/2.80*d*	14.00	22.50	13.00*g*	21.50*g*	.0575*h*	.15*h*	.05*n*	.09/.10*n*	.13/.15*n*
Cincinnati	120.00	53.75	.....	17.00	.....	.085	.....	12.25	.....	.07	.085	.....
Cleveland	120.00	30.00	3.57*l*	17.00	19.00	.085	.095	.10*h*	.11	.08	.10	.....
Dallas	.....	36.00	.....	13.65	20.30	.06	.11	16.00	24.80	.06	.05/.07	.07/.09
Denver	.....	16.11	.....	11.00	.....	10.00	.....	.045*h*	.....	.....	.....	.....
Detroit	.....	37.00	.....	18.06*f*	25.60*f*	.0734	.128	.0718*h*	.119*h*	.067	.0775	.1149
Kansas City	.....	44.00*s*	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	9.00*b*	23.00	9.50*bg*	24.00*bg*	9.50*b*	.....	.025	.072	.15
Minneapolis	.....	.....	2.017*d*	.....	27.70	.....	.126	.....	32.64	.....	.....	.....
Montreal	92.40	.....	.....	16.60*k*	24.25*k*	.116*k*	.1485*k*	.115*hk*	.135*hk*	.08*k*	.135*k*	.188*k*
New Orleans	.....	.....	.....	13.50*a*	20.00*a*	.057	.088	.06*h*	.095*h*	.....	.080	.....
New York	.....	65.00	.....	17.40	24.20*p*	14.00	.....	.0725*h*	.1325*hp*	.....	.0725*p*	.119*p*
Philadelphia	140.00	58.00	4.06	15.00*r*	.....	14.00/15.00	.....	.0625*h*	.....	.....	14.00*gr*	.....
Pittsburgh	135.00	39.75	.....	18.00	23.00	.09	.16	20.00	36.00	.07	.06	.11
St. Louis	.....	39.00	.....	16.00	22.00	15.00*g*	21.00*g*	.0575*h*	.12125*h*	.648	.06	.11
San Francisco	.....	45.00	.....	10.90	21.15	10.90*g*	18.00*gr*	12.90	17.50*r*	9.50*gr*	.0525	.1125
Seattle	.....	.....	.....	10.90*i*	21.90*i*	.....	20.40*gi*	11.40*i*	.....	.....	.0525*i*	.0625*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse *c* 3½x4x8½ in. *d* 2-in. interior block, 6-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3x3½x8½ in. *k* Tax included. *l* F.o.b. Toledo. *m* Per thousand. † Available on priority only and quoted specially. *p* No steel drum shipments except to armed forces. *r* February 1943 prices, none later available. *s* August price $42 instead of $30 reported.

Announcing

ROSIN RUBBER

—a new tire-type synthetic rubber that adds miles to your tires

NOW you can get better truck tires—tires made with a new kind of synthetic rubber—the first major improvement announced by any tire manufacturer since before the war.

These tires are made from a special synthetic rubber using rosin base soap as emulsifying agent.

Discovery of this superior rubber was made in the research laboratories of The B. F. Goodrich Company, and early development was undertaken by this company and others working on the cooperative government synthetic rubber research program. The full scale production of this new rubber and its application for tire use were pioneered by B. F. Goodrich. First tests were so startling that hundreds of tires were quickly built. Now tires made with the new rubber have undergone more than 3,000,000 miles of intensive testing under all road and climatic conditions.

Here's what these tests show as superiorities compared to tires made with ordinary synthetic rubber:

1. greater resistance to cracking
2. greater resistance to bruising
3. cooler running
4. better tread wear
5. ability to withstand higher speeds

All B. F. Goodrich truck and bus tires are now made with this new type rubber. These tires are not as good as natural-rubber truck tires but they are far and away the best synthetic truck tires we have ever built—offering you longer wear and more miles per dollar than tires built of ordinary synthetic.

B. F. Goodrich research continues to improve tires for every purpose. See the B. F. Goodrich man first for help on conservation, for service, for tires.

Truck Tires BY

B.F. Goodrich

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS	RIVETS	WIRE NAILS	SHEET PILING	STEEL RAILS (Per Gross Ton)			TRACK SUPPLIES			
		¼-in. billet *b*	½-in. structural	Base *d*	Base	Standard	Light	Re-rolled	Angle Bars	Std Spikes *c*	Tie Plates *c*	Track Bolts
Birmingham	$2.10	$2.15	$3.75	$2.90	.....	$43.00	$45.00	$45.00*	$2.70	$3.25	$2.30	$4.75
Chicago	2.10	2.15	3.75	2.90	$2.40	43.00	45.00	45.00*	2.70	3.25	2.30	4.75
Pittsburgh	2.10	2.15	3.75	2.90	2.40	43.00	45.00	45.00*	2.70	3.25	2.30	4.75
Buffalo	2.10	2.15	.....	.....	2.40	.....	.....	.....	....	....	2.30	....
Cleveland	2.10	2.15	3.75	2.90	.....	.....	.....	.....	....	....	....	....
Youngstown	....	2.15	.....	.....	.....	.....	.....	.....	....	3.25	....	....
Detroit	....	2.27‡	.....	.....	.....	.....	.....	.....	....	....	....	....
Gulf ports	2.47*a*	2.52*a*	.....	.....	2.85*a*	.....	.....	.....	....	....	....	....
Pacific ports	2.75*a*	2.80*a*	.....	3.40	2.95*a*	.....	.....	.....	....	....	....	....

‡ Delivered. *a* F.o.b. cars dock. *b* Rail steel same as billet prices. *c* Other spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on • Per net ton

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LBS., BASE PRICE

	STRUCTURAL SHAPES	REINFORCING BARS*			EXPANDED METAL LATH		WELDED FABRIC REINFORCING			SHEET PILING
	Per 100 lb. base price	Per 100 lb., ¼ in., base price: 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	Per 100 sq. yd., carload lots: Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	Per 100 sq. ft., carload lots: 4x16 in., No. 5 & 10 wires	4x12 in. No 8 & 12 wires	6x6 in. No. Per 100 s. f.	Per 100 lb. base price
Atlanta	$2.34	$2.40	$2.40	$.02½	$.10	$21.06	$23.00	$1.82	$1.35	$1.91	$3.04
Baltimore	3.70	2.90	2.75	....	.10	23.00	25.00	1.70	1.27	1.79	3.00
Birmingham	2.10*a*	2.15	2.15	.02½	.10	19.00	21.00	1.80	1.34	1.89	....
Boston	3.912	3.994	....	$20 C.L.	.10	18.50	29.50	1.76	1.31	1.84	2.77
Chicago	2.10*a*	2.15*a*	2.15*a*	.03	.05	21.50	23.50	1.67	1.25	1.75	2.40
Cincinnati	3.68	2.53*ed*	2.53*ed*	....	.05	19.50	21.50	1.66	1.25	1.74	....
Cleveland	3.588*k*	3.10*k*	3.10*k*	.02½	.10	20.50	22.50	1.66	1.25	1.74	....
Dallas	4.25	3.17	3.17	....	....	25.50	27.50	1.93	1.42	2.03	....
Denver	4.57	3.33*k*	....	....	....	26.50	26.50	1.97	1.45	2.07	....
Detroit	3.661‡	2.50‡	2.50‡	....	.10	30.00	30.00	1.68	1.26	1.76	2.66
Kansas City	4.19	2.61*cd*	2.61*cd*	.0	.05	24.50	26.50	1.78	1.33	1.87	2.87*i*
Los Angeles	3.65*f*	2.575	2.425	.02½	.05	23.00	27.50	1.93	1.42	2.03	3.65
Minneapolis	3.81‡	2.73	2.73	.0	.10	25.00	27.00	1.80	1.34	1.89	2.73*l*
Montreal	3.95*i*	2.90*i*	2.80*i*	....	....	31.00*hi*	46.00*hi*	2.76	3.44*i*	2.82*im*	....
New Orleans	4.158‡*k*	3.59*k*	....	.05	.10	23.50	22.00	1.82	1.35	1.91	2.87*i*
New York	3.75	2.76*e*	2.76*e*	....	.15	17.50	19.50	1.76	1.32	1.81	2.74
Philadelphia	3.666	3.668	....	....	....	20.50	22.50	1.71	1.28	1.79	2.72
Pittsburgh	2.10*a*	2.15*a*	2.15*a*	.02½	.10	23.00	26.50	1.59	1.20	1.67	2.40
St. Louis	3.697	2.74	2.74	.0	.05	28.00	34.00	1.69	1.27	1.78	2.70
San Francisco	4.35	2.825	2.675	.02½	.10	21.00	24.50	1.93	1.42	2.03	3.70
Seattle	2.75*e*	2.80*e*	....	....	....	34.50	38.50	1.93	1.42	2.03	2.95*e*

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus fr ight. *e* Fob dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 25c.; 1 to 5 tons, add 10c. * High scrap steel prices cut former 15c. differences between ne billet and rail steel in many mills. *h* List price. *i* Plus Dominion and Province sales tax. *k* Quotation on changed basis; no actual price change. *m* Per sq. y

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE	VITRIFIED SEWER PIPE				CLAY DRAIN TILE		CONCRETE SEWER PIPE		WROUGHT STEEL PIPE—Full standard weight. *h*			
	Per net ton f.o.b. 6 in. to 24 in.*a*	Per foot, std. 8 in., s.s.	Delivered std. 12 in., s.s	ASTM 24 in.	C13–35 36 in.	Per 1,000 ft., carload lots, f.o.b. 6 in	8 in.	Per ft., delivered; ASTM 12 in.	C 14–35 24 in.	1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in.; Lap Weld Black %	Galv. %
Atlanta	$50.66	$0.31*b*	$0.558*bc*	$3.082*c*	$5.70*c*	$110.00	$140.00	$0.45	$1.70	48.2	54.2	59.7	51.2
Baltimore	54.00	.35	.60	2.70	7.25	160.00	200.00	.65	1.90	65.5	57.5	63.0	54.5
Birmingham	46.00	.275	.495	1.95	5.50	100.00	220.00	.50	1.70	62.2	54.2	59.7	51.2
Boston	56.40	.371*r*	.7155*r*	2.79*r*	7.6875*r*	170.00‡*r*	265.00‡*r*	.60	1.95	....	....	....	....
Chicago	55.33	.35	.675	2.70	7.00	100.00‡	150.00‡	.45	1.85	66.0	55.0	64.5	53.0
Cincinnati	54.27	.231	.4455	1.80	5.125	105.00‡*s*	170.00‡*s*	.75*t*	1.75*t*	57.1	43.4	54.0	39.6
Cleveland	55.75	.266*r*	.513	2.15	5.535	90.60	139.40	.36	1.40	68.5	57.5	66.0	54.5
Dallas	57.43	.31	.58	2.25	5.00	90.00	110.00	.46	1.57	....	....	....	....
Denver	62.56	.32‡	.576‡	2.376‡	.....	143.00‡	264.00†	1.00†	2.00†	58.4	50.4	55.7	47.2
Detroit	55.75	.385	.7425	2.925	7.75	170.00‡*u*	263.00‡*u*	.36	1.75	57.6	44.0	54.5	40.2
Kansas City	56.73	.35	.59	2.20	6.20	160.00	300.00	.45	1.60	35.6	46.1	46.2	39.4
Los Angeles	69.40	.325†	.585†	2.70†	6.75†	130.50	217.50	1.00	2.00	61.1	50.1	58.6	47.1
Minneapolis	60.10	.305†	.549†	2.196†	6.25†	.....	.....	.90	2.10	64.2	53.2	60.7	49.2
Montreal	67.00	.85*o*	1.50*o*	5.25*p*	8.50*ep*	45.00*m*	64.00*m*	.48*m*†	1.92*m*†	....	....	....	....
New Orleans	52.78	.37*r*	.78	1.69	.....	150.00	220.00	.45	1.65	62.4	54.4	58.8	50.3
New York	53.40	.35	.675	2.835	7.35	.....	.....	.60	1.40	64.9	53.9	62.4	50.9
Philadelphia	52.00	.35	.675	2.75	7.50	165.00	225.00	.45	1.75	56.6	42.8	53.6	39.1
Pittsburgh	57.00	.266†	.513†	2.295†	5.945	97.80	154.20	.85*g*	2.00*g*	68.5*i*	57.5*i*	66.0*i*	54.5*i*
St. Louis	55.62	.31	.504	2.016	4.50	90.80	220.00	1.00*f*	2.15*k*	56.4	42.6	52.5	38.4
San Francisco	69.40	.3625*d*	.6525*d*	2.61	6.52	115.00	192.50	.58	2.34	45.0	31.0	41.0	26.0
Seattle	71.20	.40	.72	2.88	....	115.20	.....	.51*f*	1.44*f*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N. J. (base) $50.00 Based on existing freight rates; subject to rate change. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.; ¼ in., 8¼c.; ⅜ in., 11¼c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58¼c.; 3 in., 76¼c.; 4 in., $1.09; 6 in., $1.92; 3 per cent tax on transportation costs not included. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less on butt, 1½ on lap. Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from po producing lowest price at destination. WROUGHT IRON PIPE: Base pr and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh ba Butt-weld—1 in. and 1¼ in black 34, galv 16; 1½ in. black 38, galv 18½; 2 black 37½, galv 18. Lapweld—2½ in. to 3½ in. black 31½, gal. 14½; 4½ in. 8 in. black, 32½ galv. 17. *j* Reinforced; spec. C 76–37. *k* Reinforced; spe C 75–37. *l* Plus sales tax. *m* Tax included. *n* 27-in. pipe. *o* Less 50% *p* Less 53%. *s* Price quotations on delivered basis since Mar. 1940; curre f.o.b. price $84 for 6 in.; $130 for 8 in. *t* Reinforced pipe prices since Ma 1937; current plain pipe prices are: 12 in., 36c.; 24 in., $1.50 *u* Scar carload quantities not readily available.

IT'S THE "Know-how" THAT COUNTS

● When you call in the Raymond organization, you are turning your foundation contract over to men who are expertly trained and thoroughly experienced in every scope of the work. They know their jobs—from the preliminary investigation of underground conditions to the complete installation of the foundation.

They also know their equipment—how to handle the largest rig and the smallest tool needed in the efficient placing of Raymond Piles. And, too—they know their responsibility for carrying out large and small jobs to successful completion.

Since 1897 Raymond Concrete Piles have been continuously and increasingly used by the architectural and engineering professions. Today over 50 million lineal feet of these sturdy cast-in-place piles are in world-wide use. With over 11,000 contracts to its credit, Raymond has accumulated a vast fund of knowledge, experience and ability. Write, wire, cable or phone for a competent Raymond engineer to discuss your next project with you.

SCOPE OF RAYMOND'S ACTIVITIES

includes every recognized type of pile foundation—concrete, composite, precast, steel, pipe and wood. Also caissons, construction involving shore protection, ship building facilities, harbor and river improvements, borings for soil investigation.

RAYMOND CONCRETE PILE CO.

140 CEDAR STREET • NEW YORK 6, N. Y.

LUMBER, TIMBER PLYWOOD—PER M FT., B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) — All Fir planks No. 2 common, Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increments (See note for base price)	
	1x6 S4S	1x8 S4S	2x4 S4S	2x6 S4S	2x8 S4S	2x10 S4S	3x12 Rgh	6x12 Rgh	12x12 Rgh	2x12 Rgh	12x12 Rgh	5/8"	3/4"
Atlanta	$41.00	$41.00	$35.50	$38.50	$37.50	$41.50	$45.00	.....	.....	$60.50	$64.00	$17.90	$21.85
Baltimore	44.00	46.00	44.00	46.00	47.00	52.00	65.00	.....	.....	115.00	120.00	18.25	22.25
	48.00	*49.00*	*55.00*	*55.00*	*55.00*	*57.50*	*68.00*	*$75.00*	*$75.00*	.....	.....	.....	.....
Birmingham	45.00	45.00	44.50	43.50	44.50	47.50	68.00	55.00	56.00	.....	.....	17.35	21.15
[1]	50.00	50.00	49.50	48.50	49.50	52.50	72.00	.....	.....	67.50	70.00	.....	.....
Boston	60.00[2]	60.00[2]	60.00[2]	60.00[2]	60.00[2]	62.00[2]	66.00[2]	.....	.....	58.00[2]	58.00	18.25	22.25
	55.00	*55.00*	*54.00*	*54.00*	*54.00*	*54.00*	*58.00*	*58.00*	*58.00*	.....	.....	.....	.....
Chicago	55.00	55.00	58.50	54.00	54.00	60.00	68.00	.....	.....	80.00*l*	95.00*l*	14.60	17.80
	55.00	*55.00*	*54.00*	*54.00*	*54.00*	*55.00*	*56.00*	*56.00*	*57.00*	.....	.....	.....	.....
Cincinnati	47.50	49.00	42.50	42.50	42.50	44.50	67.00	.....	.....	65.00	65.00	17.35	21.15
	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cleveland	42.50*k*	42.50*k*	52.50*k*	51.00*k*	65.00	65.00	83.00	83.00	83.00	.....	.....	17.75	21.60
Dallas *e*	45.25	45.25	44.50	43.00	43.00	47.25	60.75	58.75	58.75	88.75	85.00	14.60	17.80
Denver ‡	68.00[4]	68.00[4]	64.75[4]	65.25[4]	63.75[4]	64.75[4]	68.75[4]	*72.00*	*72.25*	.....	.....	10.45	12.70
Detroit	61.00	61.00	57.75	57.75	57.75	63.75	71.00	.....	.....	70.75	90.00	17.35	21.15
	57.00	*57.00*	*57.00*	*57.00*	*62.75*	*72.75*	*75.00*	*75.00*	*90.00*	.....	.....	.....	.....
Kansas City *a*	69.00	69.00	67.00	65.50	67.00	69.00	84.00	.....	.....	84.00	94.00	12.60	15.40
	66.00	*66.00*	*59.50*	*59.50*	*59.50*	*59.50*	*75.00*	*80.00*	*80.00*	.....	.....	.....	.....
Los Angeles *a*	*60.00*	*60.00*	*60.50*	*60.75*	*59.25*	*59.25*	*72.75*	*72.00*	*72.00*	.....	.....	9.90*gh*	12.05*gh*
Minneapolis ‡*b*	62.00[8]	61.00[8]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.60	15.40
‡	*69.00*	*69.00*	*60.00*	*61.00*	*59.00*	*60.00*	*61.00*	*68.00*	*68.00*	.....	.....	.....	.....
Montreal ††	*64.00*	*65.00*	*60.00*	*63.00*	*65.00*	*70.00*	.....	.....	.....	200.00	200.00	.....	.....
	90.00	*90.00*	*90.00*	*90.00*	*90.00*	*90.00*	*80.00*	*80.00*	*80.00*	.....	.....	.....	.....
New Orleans	41.00	39.50	37.00	35.00	34.00	36.00	46.00	.....	.....	55.00	69.00	14.60	17.80
	30.50	*30.50*	*30.00*	*30.00*	*29.00*	*29.00*	*28.50*	*29.50*	*29.50*	.....	.....	.....	.....
New York	67.50	67.50	62.50	62.50	62.50	64.00	74.00	.....	.....	120.00*f*	125.00*f*	18.35	22.25
‡	.....	.....	*65.00i*	*65.00i*	*65.00i*	*65.00i*	[Range from $75 to $95]			.....	.....	.....	.....
Philadelphia	75.00	75.00	75.00	75.00	75.00	75.00	75.00	.....	.....	130.00	130.00	18.25	22.25
	75.00	*75.00*	*75.00*	*75.00*	*75.00*	*75.00*	*85.00*	*90.00*	*90.00*	.....	.....	.....	.....
Pittsburgh	50.80	53.20	62.75	55.00	60.85	62.50	76.25	.....	.....	.....	.....	18.10	22.05
	69.20	*68.10*	*66.10*	*65.30*	*65.20*	*65.65*	*82.75*	*88.75*	*88.75*	.....	.....	.....	.....
St. Louis ‡*c*	61.00	61.00	57.00	56.00	57.00	59.00	71.00	*75.00*	*75.00*	87.00	87.00	14.60	17.80
San Francisco *d*	*41.00*	*41.00*	*36.50*	*36.75*	*35.75*	*35.75*	*37.50*	*36.00*	*36.00*	.....	.....	7.30*g*	8.90*g*
Seattle	*51.25*	*51.25*	*45.75*	*45.75*	*44.50*	*44.50*	*47.00*	*47.75*	*46.50*	.....	.....	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Spruce. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* F.o.b. cars San Francisco freight rate. *e* 10% discount taken off. *f* Up to 18 ft. † Plus sales tax.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on 5/8", $95.15; on 3/4", $104.85; price includes oiling and sealing charges. For other centers add rail freight increment from table or proper size. For resin dipped treatment, add $10.50 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum. *i* Ranges from $65 to $75. *j* Average price. *k* August 1943 price. *l* September price; none later available.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from jobbers list, Aug. 15, 1938 — Single or Double Thickness		EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*
	A quality	B quality	
Atlanta	74%	75%	$0.15
Baltimore	78%	79%	.15
Birmingham	76%	76%	.105
Boston	77%	78%	.15
Chicago	77%	77%	.15
Cincinnati	77–10%	77–10%	.15
Cleveland	77%	77%	.19
Dallas	76%	76%	.1625
Denver	76%	76%	.155*e*
Detroit	77%	77%	.1575
Kansas City	77–10%	77–10%	.155
Los Angeles	86%*d*	88%*d*	.1575
Minneapolis	77%	77%	.155
Montreal	40–10–2%*ab*	50–2%*ac*	.1675†
New Orleans	70%	75%	.16
New York	81%	82%	.22*f*
Philadelphia	78%	79%	.15
Pittsburgh	79%	79%	.1225
St. Louis	77–10%	77–10%	.155
San Francisco	66%	73%	.155
Seattle	75%	75%	.1575†

Price of 60% Ammonia Gelatin is $0.01 per lb. higher than 40%

a Discount from list Sept. 1939; sales tax included, but 6% tax exemption not allowed for. *b* Single thickness. *c* Double thickness. *d* Discount from jobbers' list Sept. 15, 1928.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal St. add delivery charge of $6.00 per trip. [1] F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 29,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla. and Me.	$0.105	$0.13	$0.15
W. of Miss. to Rocky Mtn. States, Fla. and Maine.	.11 –.1175	.135 –.1475	.155 –.1675
Rocky Mtn. States	.11 –.1225	.135 –.1525‡	.155 –.1725‡
Pacific N. W. States	.1075–.12	.1375–.15	.1575–.17
Pacific S. W. States	.1050–.1125	.135 –.1425	.155 –.1625

‡ F.o.b. Louviers, Colo., or Butte, Mont.

PILES TIES— F.O.B.

PILES

Prices per linear foot, fir and pine, bark on, f.o.b. cars, New York. Fir based on Wash. and Ore. points to New York shipping area; pine based on freight from Norfolk.

Dimensions	Points	Length	By Rail — Pine*	By Rail — Fir
12-in. at butt	6-in.	30 to 50-ft.	$0.34	.....
12 in.— 2 ft. from butt	6-in.	50 to 59-ft.	.35	.....
12-in.— 2 ft. from butt	6-in.	60 to 69-ft.	.36	.....
12-in.— 2 ft. from butt	6-in.	90 to 100-ft.	....	.5875
13-in.— 3-ft. from butt	5-in.	91 to 100-ft	....	.5608
14-in.— 2-ft. from butt	6-in.	50 to 69-ft.	.41	.6175
14-in.— 2-ft. from butt	6-in.	70 to 79-ft.	.43	.59
14-in.— 2-ft. from butt	5-in.	80 to 85-ft.	.54	.....
14-in.— 2-ft. from butt	5-in.	85 to 89-ft.	.57	.....
14-in.— 2-ft. from butt	5-in.	90 to 100-ft	....	.60

* Pine piling over 80-ft. available only in limited quantities.

RAILWAY TIES

Prices f.o.b., per tie for carload lots:		6"x8"x8' Untr.	6"x8"x8' Tr.	7"x9"x8'6" Untr.	7"x9"x8'6" Tr.
Boston	Oak	$1.50	....	$2.00	....
	Pine	2.00	$3.00*a*	2.50	$3.00*a*
New York	S. L. Sap Pine	1.43/1.54	2.59	1.76	2.86
	Mixed Oak	1.71	2.59	2.42	3.58
Birmingham	White Oak	1.00	1.60*a*	....	2.25*a*
Chicago	Red Oak	....	2.45/2.65*a*	....	3.35/3.60
Los Angeles	Douglas Fir	2.00	3.25*a*	2.90	4.70*a*
Philadelphia	Red Oak	....	2.10*ag*	....	3.25*ag*
St. Louis	White Oak	1.63	....	2.19	....
	Red Oak	1.63	2.20*a*	2.19	3.04*a*
	Sap Pine or Cypress	1.70	....	2.06	....
San Francisco	Douglas Fir	1.25*bef*	....	....	3.00*ef*
Montreal	Birch or Maple	....	1.65	1.04	....

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6"x8"x8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* F.o.b. cars. † Out of market. *g* January 1943 price; none later available.

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.50– 3.10
Chlorine cylinders, liquid, per lb., delivered	.0535
Calcium chloride, 77–80%, flaked, 100-lb. paper bag, del'd, ton.	18.50–35.00
Silicate of soda, 52 deg. in drums, f.o.b. works, per 100 lb	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.15
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00–25.00
Sulphate of copper, in bbl., per 100-lb	5.00

How to make Better Time...

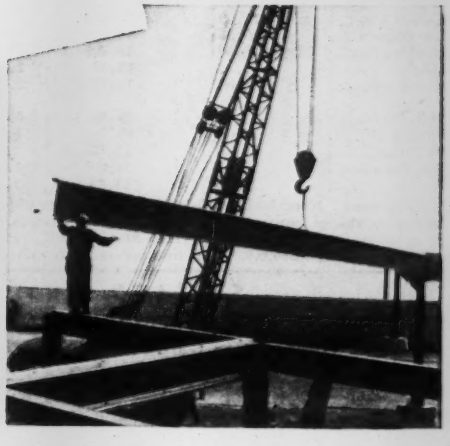
CABLE trouble can play the devil with construction schedules. That's why wire rope performance is one of the most important factors in determining dirt-moving profits. The better the cable, the more efficient becomes your equipment . . . the faster your job moves along.

TIGER BRAND Excellay Preformed Wire Rope doesn't have to be broken in. You can put it to work at once. Its *preformed* construction gives it *greater* fatigue resistance. You get top production because each strand bears its full share of the load. This superior cable runs true in sheave grooves, spools evenly at all speeds under light or heavy loads.

Important, too, is TIGER BRAND's safety advantage. Crown wires lie flat and in place even when broken . . . do not stick out to tear hands and clothes of your men.

Prepare now to use U·S·S American TIGER BRAND Excellay Preformed Wire Rope on your next job. Specify it for new equipment . . . re-rig your old equipment with it.

Excellay Preformed



AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York
COLUMBIA STEEL COMPANY
San Francisco
United States Steel Export Company, New York
UNITED STATES STEEL

USS STEEL
UNITED STATES STEEL

U·S·S AMERICAN

TIGER BRAND *Wire Rope*

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE PARTITION — SCORED Per M lots of 2,000 pieces or over,			STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M lots of 2,000 pieces or over,			BRICK Per M in quantity		LIME		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Per ton, Hydrated finishing	In paper, Common hydrated	Carload, Pulverized or lump
Atlanta	$104.00	$114.00	$199.00	$234.00	$244.00	$250.00	$18.25	$20.04	$26.54	$15.04	$15.04
Baltimore	84.00	90.00	170.00	200.00	260.00	300.00	17.00*k*	21.00*k*	19.00	14.00	2.50
Birmingham	80.00	85.00	160.00	191.00	252.00	288.00	16.50	23.00	18.11	13.64	2.25
Boston	103.75*a*	110.65*a*	207.45*a*	248.90	.....	.....	20.00*i*	20.00*i*	21.00†	.....	16.00
Chicago	79.50	85.00	160.00	197.00	243.00	278.00	15.00	16.00	17.00	15.00	12.75
Cincinnati	65.55	69.90	131.20	148.70	210.35	240.45	25.75	25.75	15.50	13.00	.....
Cleveland	82.50	97.35	182.50	.....	.....	.....	20.75	20.00	15.75	13.25	.....
Dallas	71.40	76.40	145.30	183.50	238.00	294.50	15.25*i*	16.75*i*	19.00	15.00	15.00
Denver	91.20	102.60	165.30	189.80	228.00	262.20	19.50	18.00	25.00*j*	17.00*j*	20.00
Detroit	92.70	96.70	174.50	198.80	257.20	294.30	20.50	20.50	18.00	16.00	16.00
Kansas City	67.00	69.00	89.00*c*	128.00	163.00	189.00	17.50	18.50	19.32	13.00	10.92
Los Angeles	73.50†*r*	89.50†*r*	128.00†*r*	210.00†*r*	368.00†*r*	460.00†*r*	13.50	15.00	16.50	17.50	17.50
Minneapolis	87.00*b*	92.80*b*	157.30*b*	.....	189.00*b*	262.00*b*	25.50	31.50*g*	21.00	16.00	19.00
Montreal	92.50*a*	98.50*a*	196.25*a*	151.50*a*	100.50*at*	134.50*au*	22.16†*u*	33.20†*u*	25.00*u*	14.10*u*	20.00
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	90.80	96.80	133.10*c*	219.80*h*	269.80*h*	333.90*h*	17.50/18.50*z*	.....	20.00	14.00	17.00
Philadelphia	104.20	111.20	208.40	250.10	305.10	377.70	18.75	21.75	19.00	16.00	15.00
Pittsburgh	74.20	79.15	148.40	233.00	284.00	325.00	21.25	23.25	17.90	15.40	2.35
St. Louis	67.00	72.00	130.00	190.00	244.00	290.00†	20.50	19.50	22.00	18.00	2.50
San Francisco	96.00	108.00	144.00	108.00*t*	.....	.....	21.50	.....	24.00	23.00	2.50
Seattle	115.00	125.00	230.00	.....	.....	.....	20.50*f*	24.00*f*	20.00*s*	20.00*s*	20.00

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6x12x12 in., 3-cell. *d* Not load bearing. *e* 48 lb. tile. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* F.o.b. Warehouse only. *f* LCL. *k* $1.00 discount if paid in 10 days. *l* Lump. *m* Per bbl., 180 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *r* 5% discount 10 days. *s* 2% discount for cash. *t* 5½x8x12. *u* 8% sales tax included. *v* 6x12x12. *w* Per 200 lb. bag. *x* Price withdrawn; May 1945 quotation.

PAINT, ROOFING—F.O.B. CARLOAD LOTS

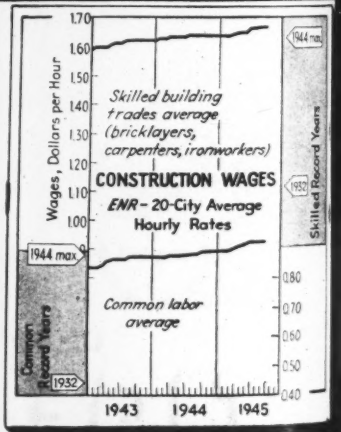
	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *b*	Ferric Oxide *d*	ROOFING SUPPLIES Rolls, slate surfaced, 85–90 lb. per sq.	Asphalt felt, per 100 lb.	Carload lots f.o.b. factory Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch, 350 lb. bbl, per ton
Atlanta	$10.25	$14.125	$1.30	$2.25	$1.20	$1.85	$1.72	$1.72	$0.305	$27.00
Baltimore	10.00	13.75	2.00	3.00	2.50	2.30	2.70	2.70	.40	29.00
Birmingham	10.25	14.125	2.35	3.50*r*	1.98*r*	2.09	1.98	1.98	.32	28.35
Boston	10.00	13.75	1.75	2.50	2.31	2.00‡*h*	3.30‡*u**v*	3.3C‡*u**v*	.25‡	21.00
Chicago	10.00	13.75	....	....	....	1.75*h**f*	1.74*h**f*	1.82*h**f*	.33*f*	23.00
Cincinnati	10.00	13.75	1.70	2.90	1.60	2.20	2.10*h*	2.10*h*	.33	25.00
Cleveland	10.00	13.75	1.70	2.90	1.60	1.71	1.63*h*	1.63*h*	.257	25.00
Dallas	10.00	14.50	1.88	2.11*n*	.05*l*	1.75*h*	1.66*h*	1.66*h*	.35	39.00
Denver	10.50	14.25	....	....	.27*l*	2.45	2.95	2.95	.35	28.00
Detroit	10.00	13.75	1.75	3.00	1.60	2.25	2.25	2.25	.50	23.00
Kansas City	10.00	13.875	2.30*g*	2.55*gr*	2.16*g*	2.19	2.30	2.30	.28	27.50
Los Angeles	10.25	14.25	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	10.00	13.875	....	....	....	1.7123*i*	1.6243*h**i*	1.6243*h**i*	.32	23.00
Montreal	.....	11.05	2.50*p*	4.90*p*	3.15*p*	4.02*t*	2.58*t*	3.01*t*	.89*t*	2.10
New York	10.00	13.75	2.03	....*r*	1.82	1.7098	1.6273*a*	1.6273*o*	.26	23.00
Philadelphia	10.00	13.75	1.60/1.80	2.20*r*	1.55	2.25	2.71	2.71	.32	23.00
Pittsburgh	10.00	13.75	1.05	1.95	.80	1.95	1.84*h*	1.84*h*	.34	26.00
St. Louis	10.00	13.75	2.28*s*	2.89*s*	1.96*s*	1.92	1.66	1.66	.36	24.00
San Francisco	10.25	14.00	1.80	2.75*n*	1.35	1.71	2.40	2.40	.33	20.50
Seattle	10.25	14.25	1.90	3.00	....	2.15	2.16*h*	....	.35	26.50

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3–49A. *c* ASTM Spec. D266–31. *d* 80% minimum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 5 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* Per 100 lb. *l* Per lb. *m* Per bbl. *n* May, 1941 price. *o* 60-lb. roll. *p* Plus 8% sales tax. *r* Not available, except on priority rating; then quoted specially. *s* December 1942 price. *t* Federal tax included. *u* 90-lb. roll. *v* Truck delivery.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.50	$1.25	$1.50	$1.25	$1.50	$0.40	$0.50
Baltimore	1.75	1.4375	1.80	1.625/1.80	1.725	.80	.80
Birmingham	1.75	1.25	1.625	1.375 /1.625	1.65	.65	.65
Boston	1.625	1.50	1.675	1.50 /1.875	1.667	1.00	1.00
Chicago	1.90	1.85	1.85	1.85	1.85	1.20	1.20
Cincinnati	1.825	1.60	1.725	1.45 /1.60	1.75	.90	.90
Cleveland	1.875*c*	1.575	1.875	1.875	1.875	1.085	1.125/1.155
Dallas	1.625	1.25	1.50	1.75	1.625	.60	.75 /1.25
Denver	1.80*b*	1.50*b*	1.50*b*	1.50 /1.625*b*	1.35	.825*b*	.825*b*
Detroit	1.725	1.50	1.825	1.675/1.825	1.725	1.00	1.00
Kansas City	1.75	1.575	1.70	1.675	1.75	.975	.90
Los Angeles	1.50	1.35	1.625	1.375	1.667	.875	.875
Minneapolis	1.625	1.44	1.625	1.50	1.625	.95	.95
New Orleans	1.625	1.375	1.625	1.55	1.50	.70	.80
New York	2.00*b*	1.85*b*	2.00	2.00*b*	2.00*b*	1.10	1.10
Philadelphia	2.00	1.58	1.90/2.00	2.25	2.00	.90	.90
Pittsburgh	1.90	1.75	1.75	1.8125	1.875	1.00	.90
St. Louis	1.90	1.70	1.75	2.00	1.75	1.00	1.00
San Francisco	1.875	1.50	1.75	1.50/1.75	1.75	1.00	1.00
Seattle	1.845	1.545	1.745	2.00*	1.845	1.145	1.145
Montreal*	1.06	.96	1.01	.91	1.06	.61	.66

b 7 hr. day. *c* Prevailing rate on government work.
* Cost of living bonus now included in basic wage.



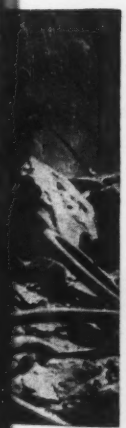
ENR Skilled Average; (Bricklayers, Carpenters, Ironworkers) **$1.670.**
ENR Common Average; $0.917.

10 ADVANTAGES

1. Extreme flexibility—easy to handle
2. Resists kinking
3. Light in weight
4. Practically inseparable cover and plies—balanced homogeneous construction
5. Withstands high pressures and surges with wide margin of safety
6. Uniform inside diameter
7. Less elongation and expansion
8. Less fatigue to operator
9. More production
10. Lower ultimate cost

Condor HOMO-FLEX HOSE

contributes to greater production and longer hose life



Every one of these 10 advantages contribute to the multiple economies of long service life; resistance to high working pressures and surges; easy handling with less operator fatigue; toughness to withstand wear, abrasion and kinking.

Still another **MANHATTAN** advantage—Turnate Vulcanization—imparts added strength to Homo-Flex Hose. This process gives uniform inside and outside diameters, uniform texture and resiliency to the **MANHATTAN** Strength Members and the **FLEXLASTICS** tube and cover.

Condor Homo-Flex Hose is or will be available in types for the following services: Air, Water, Steam Pressing Iron, Orchard Spray, High Pressure Mine Spray, High Pressure Oil Spray. Write for Bulletin No. 6879.

The term FLEXLASTICS is an exclusive MANHATTAN trade mark. Only MANHATTAN can make FLEXLASTICS.

THE MANHATTAN RUBBER MFG. DIVISION

OF RAYBESTOS-MANHATTAN, INC.

Executive Offices and Factories **PASSAIC, NEW JERSEY**

Worthington-Ransome Blue Brute Distributors

By referring to the advertisement on page 141, you'll learn the meaning of the (1), (2) or (1-2) beside their names.

Ala., Birmingham (1) J. D. Pittman Tractor Co.
Ariz., Phoenix (2) Smith Booth Usher Co.
Ark., Fort Smith (2) R. A. Young & Son
Little Rock (1) Kern-Limerick, Inc.
Little Rock (2) R. A. Young & Son
Calif., Los Angeles (1) Garlinghouse Bros.
Los Angeles (2) Smith Booth Usher Co.
San Francisco (2) Coast Equipment Co.
Colo., Denver (2) John N. Meade
Denver (1-2) Power Equipment Co.
Conn., Hartford (2) The Holmes-Talcott Co.
New Haven (1) W. I. Clark
Waterbury (1) Contractors Supply Co.
Del., Smyrna (1) King-Burrous
D. C., Washington (1) M. A. Doetsch Machinery Co.
Fla., Jacksonville (1) Julien P. Benjamin, Inc.
Tampa (2) S. M. Regar
Ga., Atlanta (2) Tractor & Machinery Co.
Savannah (1) Morgans, Inc.
Ida., Boise (1-2) Olson Manufacturing Co.
Ill., Chicago (1-2) Chicago Construction Equipment Co.
Chicago (2) John A. Roche
Chicago (1) Thomas Hoist Co.
Ind., Fort Wayne (1) American Steel Supply Co.
Indianapolis (2) Reid-Holcomb Co.
Iowa, Des Moines (2) Electric Eng. & Const. Co.
Ky., Harlan (2) Hall Equipment Sales Co.
Louisville (2) T. C. Coleman & Son
Louisville (2) Williams Tractor Co.
Paducah (1) Henry A. Petter Supply Co.
La., New Orleans (1) Ole K. Olson Co.
New Orleans (2) Wm. F. Surgi Equipment Co.
Maine, Portland (1-2) Maine Truck-Tractor Co.
Md., Baltimore (1) Stuart M. Christhilf & Co.
Baltimore (2) D. C. Elphinstone, Inc.
Mass., Boston, Allston (1-2) Clark-Wilcox Co.
Cambridge (2) W. W. Field & Son, Inc.
Mich., Detroit (1) T. G. Abrams
Detroit (2) W. H. Anderson Co., Inc.
Flint (2) Gransden-Hall & Co.
Muskegon (1-2) Lakeshore Machinery & Supply Co.
Minn., Minneapolis (1-2) Phillippi-Murphy Equipt. Co.
St. Paul (2) D. L. O'Brien
Miss., Jackson (1) Jackson Road Equipment Co.
Mo., Clayton (1-2) The Howard Corporation
Kansas City (1) Brown-Strauss Corp.
Kansas City (2) Machinery & Supplies Co.
St. Louis (2) W. H. Reaves
Neb., Lincoln (1) Highway Equipment & Supply Co.
N. J., Hillside (2) P. A. Drobach
Newark (1) Johnson & Dealaman
North Bergen (2) American Air Compressor Corp.
N. M., Albuquerque (2) Bud Fisher Co.
Albuquerque (1) Morrow & Co.
Roswell (2) Smith Machinery Co.
N. Y., Albany (1-2) Milton-Hale Machinery Co.
Buffalo (2) Dow & Co., Inc.
New York (2) Air Compressor Rental & Sales
New York (1-2) Hodge & Hammond, Inc.
New York (1-2) Railroad Materials Corporation
Olean (2) Freeborn Equipment Co.
N. C., Raleigh (2) Carolina Tractor & Equipment Co.
N. D., Fargo (1-2) Smith Commercial Body Works, Inc.
O., Cincinnati (2) Finn Equipment Co.
Cleveland (2) S. M. Clancey
Cleveland (1) H. B. Fuller Equipment Co.
Cleveland (2) Gibson-Stewart Co.
Marietta (2) Northwest Supply & Equipment Co.
Toledo (1) Edmund Supply Co.
Toledo (2) M. W. Kilcorse & Co.
Okla., Oklahoma City (2) Townsco Equipment Co.
Oregon, Portland (2) Andrews Equipment Service
Pa., Allentown (2) H. N. Crowder, Jr., Inc.
Easton (2) Sears & Bowers
Harrisburg (2) N. A. Coulter
Oil City (2) Freeborn Equipment Co.
Philadelphia (1) Giles & Ransome
Philadelphia (2) Metalweld, Inc.
Pittsburgh (2) Atlas Equipment Corp.
Wilkes-Barre (2) Ensminger & Co.
Wilkinsburg (1) Arrow Supply Co.
York (2) George F. Motters Sons
S. C., Columbia (2) Smith Equipment Co.
Tenn., Knoxville (2) Wilson-Weesner-Wilkinson
Memphis (2) Tri-State Equipment Co.
Tex., Dallas (1) Service Equipment Co.
Dallas (2) Shaw Equipment Co.
El Paso (2) Equipment Supply Co.
El Paso (1) Mine and Smelter Supply Co.
Houston (2) Dye Welding Supply Co.
Houston (1) McCall Tractor & Equipment Co.
San Antonio (2) Patten Machinery Co.
San Antonio (1) San Antonio Machine & Supply Co.
Utah, Salt Lake City (1-2) Landes Engineering Co.
Vt., Barre (1-2) A. M. Flanders, Inc.
Va., Richmond (2) Highway Machinery & Supply Co.
Wash., Seattle (1) Columbia Equipment Co.
Seattle (2) Star Machinery Co.
Spokane (2) Andrews Equipment Service
Spokane (1) Columbia Equipment Co.
W. Va., Charleston (1) West Virginia Co.
Fairmont (2) Interstate Engineers & Constr., Inc.
Wisc., Milwaukee (1) Mekeel Engineering Co.
Wyoming, Cheyenne (2) Wilson Equipment & Supply Co.

Blue Brute Booms

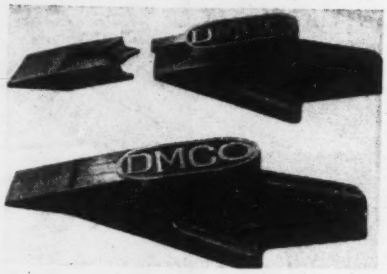
Worthington Pump and Machinery Corp.

Worthington-Ransome Construction Equipment Division
Holyoke, Massachusetts

New Aids to the Constructor

Two-Piece Dipper Tooth

Recommended for use on a wide range of digging and loading equipment, a new two-piece "Wear-Sharp Tooth" is said to effect considerable saving in welding materials and time. The



"Penetrater" point is double-keyed to the "Weldapter" and tack-welded at several points along the side and across the end where the parts join. Up and down digging stresses, side thrusts and impact shocks are taken by the double-key supports, one lengthwise and one crosswise of both parts.

The point of heat-treated alloy steel forgings has a sharp, thin cutting edge that penetrates difficult material with a minimum of power; it is said to stay sharp until half worn away—*Daniels-Murtaugh Co., 625 C Avenue N.W., Cedar Rapids, Iowa.*

• • •

Nut Latch

Instant attachment and removal of box covers, access doors, panels and inspection plates are facilitated with the new spring steel speed nut latch No. 1663. Available in five material thicknesses to provide desired pull-out tension, the speed nut has spring arms that snap over ball or grooved studs, which may be quickly withdrawn.—*Tinnerman Products, Inc., 2120 Fulton Road, Cleveland 13, Ohio.*

• • •

Airtight Door

An interesting variation in door design is found in a new air-tight vertical-lift door, provided with a blow-out panel that will let loose or blow outward in case of any explosion, thus relieving inside pressure. The door is spring counterbalanced and motor operated; when it is closed, air-inflated rubber tubes, controlled by valves and push-button operated, establish airtightness.

Although the door can be raised or lowered without putting the air-sealing mechanism into operation, it is so interlocked that should the door be closed and sealed, the motor will not raise the door until the air-seals have automatically deflated.—*The Kinnear Mfg. Co., Columbus, Ohio.*

• • •

Small Industrial Engines

Continuous operation of up to 2,500 hours between major inspections is claimed in some instances for new "Mercury" engines. These all-purpose, two-cycle, air-cooled small industrial engines operate efficiently on leaded gasoline and detergent oil. A new ignition circuit and a special magneto are used. Other improvements include forged steel anti-friction connection rods, ball bearing crankshaft and low piston speeds.

Mechanical efficiencies of 94 percent have been observed, with proportional fuel economy.—*Kiekhaefer Corp., Cedarburg, Wis.*

• • •

Air-Actuated Clutch

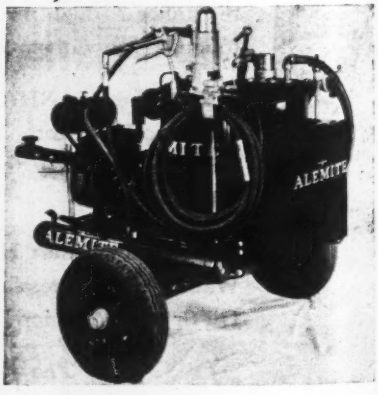
Operating by remote control, the twin disc Model P air-actuated clutch retains many of the features of the heavy-duty Model E friction clutch.

Model P has a hub and back plate, center plate, floating plate and friction discs; available in sizes from 14 to 36 in., it has 65 to 895 hp. capacity.—*Twin Disc Clutch Co., Racine, Wis.*

• • •

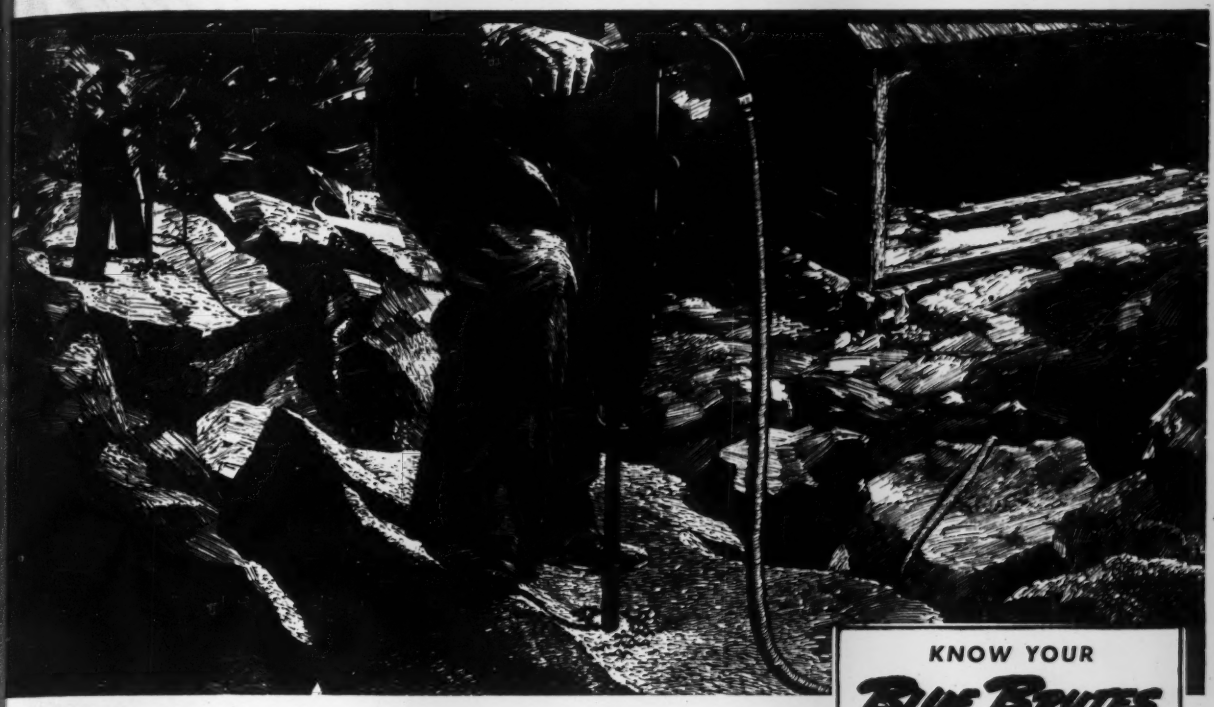
Portable Service Station

High pressure lubrication, tire inflation and application of rust preventive or other surfacing material are three of the functions performed by a new small portable unit. This 246-lb. ma-



chine has its own 1½ hp. air compressor, driven by a gasoline motor; the tubular base on which it is mounted

MORE FOOTAGE FROM DRILL RUNNERS



When easy-handling Blue Brute Hand-held Rock Drills are powered by an easy-breathing 315′ Blue Brute Diesel-driven Compressor, for example, it's easy to understand why you can get more footage in less time at lower cost.

Your drill runners will work longer and steadier without tiring. That's because Worthington . . . pioneer in "ease-of-operation" drills . . . designs and makes its sturdy, hand-held drill to work *with* and *not against* the operator. He simply holds the drill while its powerful hammering rotation does the work.

Your Blue Brute Compressor will supply more air per gallon of fuel. That's because Worthington Feather* Valves — lightest, tightest, most efficient valve ever designed for compressor use . . . full-force feed lubrication throughout engine and compressor . . . unique idling control . . . all combine to keep performance at the peak and maintenance costs at rock-bottom.

For further proof that your best buys in rock drills, air tools and compressors are Blue Brutes, talk things over with your nearby Worthington Representative.

*Reg. U. S. Pat Off.

H5.7

KNOW YOUR BLUE BRUTES

Your Blue Brute Distributor will gladly show you how Worthington-Ransome Blue Brute construction equipment will put your planning on a profitable basis and prove that *there's more worth in Worthington-Ransome.* Act now! His name is listed on page 140 The number beside his name indicates the Blue Brutes he handles.

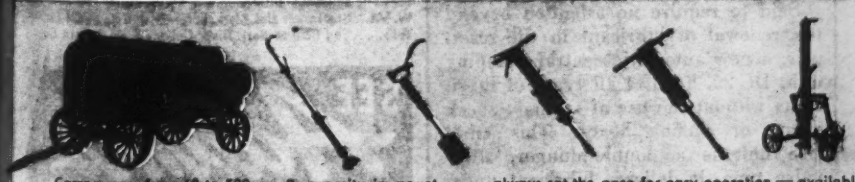
1.
Blue Brutes include: Pavers, Concrete Spreaders**, Concrete Mixers, Concrete Placing Equipment, Big Mixers, Finishing Machines**, Pneumatic Placing & Grouting Equipment, Truck Mixers, Plaster & Bituminous Mixers, and accessories.

2.
Blue Brutes also include: Diesel, gasoline and electric driven Portable Compressors from 60 to 500 cu. ft. capacity in mountings to suit all jobs; Rock Drills and Air Tools in a wide range of weights and sizes; Contractors' Pumps.**

**Postwar Products

Get more **WORTH** *from air with* **WORTHINGTON**

BUY BLUE BRUTES



Compressors from 60 to 500 cu. ft. capacity in mountings to suit all jobs. Rock Drills and Air Tools that have always set the pace for easy operation — available in a wide range of weights and sizes.

WORTHINGTON

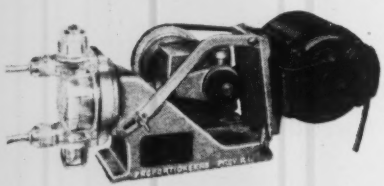
Worthington Pump and Machinery Corporation, Worthington-Ransome Construction Equipment Division Holyoke, Mass.

The Camel that walked a mile for a drink...

Cleo was a smart camel, as camels go. She needed a lot of water to keep her humping, and that water had to be good. Cleo didn't know the danger of untreated water but she'd walk a mile any time for a bracing drink of pure water.

Men are smarter than camels: they don't have to leave town for a good drink. Wise water works operators use % Proportioneers % Heavy Duty Midget Chem-O-Feeder and give their communities pure, safe water right on tap. Hypochlorination with Chem-O-Feeder is the simple, dependable and economical method of water purification. The chemical feeding rate is easily adjustable and "See-Thru" construction shows movement of valves and the flow of the liquid. By cross-connecting the Chem-O-Feeder to the water pump, automatic injection is accomplished.

End your water treating problems with % Proportioneers % Chemical Feeders... equipment is available for every operating condition. Information on request.



%Proportioneers% Heavy Duty Midget Chem-O-Feeder

% PROPORTIONEERS, INC. %

92 CODDING STREET, PROVIDENCE 1, R. I.

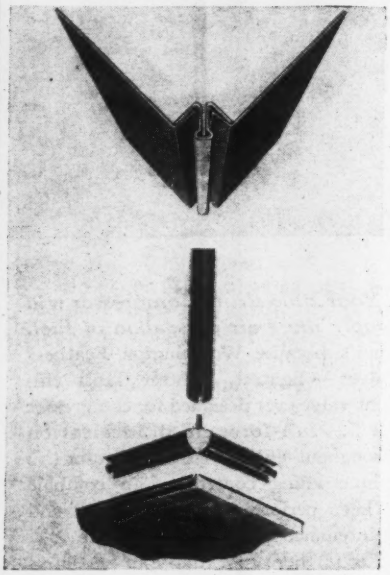
serves as an air tank or reservoir.

Among the unit's accessories are: a tire inflation hose and chuck; a spray gun to handle paint, rust preventive, etc.; one high and one low-pressure lubrication pump, each of which delivers lubricant from its own reservoir or 50-lb. capacity container. Constant pressure of 130 lb. is maintained; an automatic cut-off prevents greater pressure. *—Alemite Division, Stewart-Warner Corp., 1826 West Diversey Parkway, Chicago 14, Ill.*

• • •

Snap-Assembly Construction

Consisting of only three basic parts—framing, sheets and fittings—the new light-metal construction known as Lindsay Struc-Lok, is prefabricated in both aluminum and steel. It requires no



bolts, screws, rivets or welds. All parts are accurately die-formed by mass production, in many sizes.

Special fittings connect the framing and hold it together, while the flanged edges of the sheets are snapped into die-rolled frame channels and lock permanently into position.—*Lindsay & Lindsay, 222 West Adams St., Chicago 6, Ill.*

• • •

Central Pumping Unit

Said to require no attention beyond the renewal of lubricant in the reservoir, a new automatic central pumping unit, DC-25, handles all types of lubricants without the use of springs, check valves or stuffing boxes. This small size unit is a double-plunger, slide-valve type. It delivers lubricant under pressure to all bearings through two main supply lines, serving a measuring

Adams DISTRIBUTORS

Headquarters for MACHINERY and SERVICE

ALA.... Montgomery—Ray-Brooks Machinery Company
Birmingham—Tractor & Equipment Company
ALASK.. Fairbanks—Glenn Carrington & Company
ARIZ... Phoenix—O. S. Stapley Company
ARK.... Little Rock—Little Rock Road Machinery Co.
CALIF.. Los Angeles—Lee & Thatro Equip. Co.
Sacramento—Sutton Tractor & Equipment Company
Redding—J. G. Bastain
San Jose and San Francisco—Valley Equipment Co.
Fresno—Brown Tractor Co.
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DEL.... Phillips Machinery & Tractor Co., Baltimore
FLA.... Jacksonville, Miami, Tampa—Florida Equipment Co.
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GA.... Atlanta—Tri-State, Inc.
Albany—Tri-State Tractor Company
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MD.... Baltimore—Phillips Machinery & Tractor Co.
MASS... Newton Highlands—Tractors, Inc.
MICH... Bark River—Bark River Culvert & Equipment Co.
Detroit and Grand Rapids—
Wolverine Tractor & Equipment Co.
MINN... Minneapolis & Duluth—Rosholt Equipment Co.
MISS... Jackson—Mississippi Road Supply Co.
MO.... St. Louis—Missouri-Illinois Tractor & Equip. Co.
Kansas City—Noel V. Wood, Inc.
MONT.. Billings & Missoula—Industrial Equipment Co.
NEB.... Omaha—Nebraska Tractor & Equipment Company
North Platte—Cornhusker Tractor & Equip. Co.
NEV.... Reno—Brown Motors
N. H.... Manchester—R. C. Hazelton Co.
N. J.... Trenton—Ross, Young, Dilts Company
N.M.... Albuquerque—Hardin & Coggins
N. Y.... Buffalo—Dow & Company, Inc.
Brooklyn—Edward Ehrbar, Inc.
Long Island—George Malvese & Co.
Albany, Syracuse—Milton-Hale Mach. Co.
N. C.... Raleigh—J. B. Hunt & Sons
N. D.... Fargo—Myhra Equipment Company
OHIO... Cleveland—Gibson-Stewart Company
Cincinnati—Rish Equipment Co.
Cambridge—Major Equipment Co.
OKLA... Tulsa & Guthrie—C. L. Boyd Company, Inc.
ORE.... Portland & Eugene—Howard-Cooper Corporation
PA.... Butler—National Equipment Co.
Pittsburgh—Atlas Equipment Corp.
Philadelphia—Service Supply Corp.
Harrisburg & Wilkes-Barre (Kingston)—
State Equipment Co.
R. I.... Providence—Tractors, Inc.
S. C.... Columbia—N. H. Summers Road Machinery Co.
S. D.... Sioux Falls, Rapid City—Empire Equipment Company
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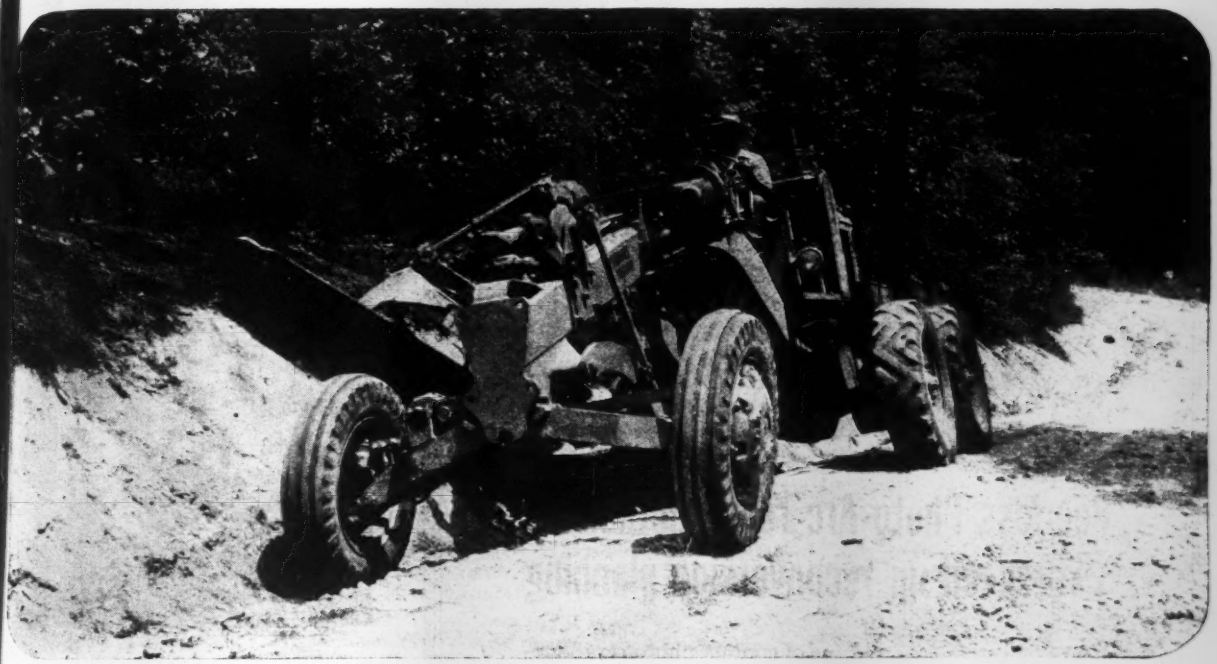
Nashville—Industrial Tractor & Equipment Co., Inc.
Memphis—Road Builders Equipment Co.
TEXAS.. Dallas & Houston—Browning-Ferris Machinery Co.
San Antonio—Jess McNeel Machinery Co.
Plainview & Sweetwater—Plains Mach. Co.
UTAH... Salt Lake City—The Lang Company
VA.... Richmond—Municipal Sales Company
Richmond and Roanoke—Rish Equipment Co.
Alexandria—Phillips Mach. & Tractor Co.
WASH.. Seattle—Howard-Cooper Corp.
Spokane—Intermountain Equip. Co.
W. VA... Charleston and Clarksburg—Rish Equipment Co.
WIS. ... Eau Claire—Bark River Culvert & Equipment Co.

SEE Adams AD ON OPPOSITE PAGE



...YOU GET THEM ALL IN ADAMS!

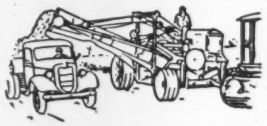
★Judged by any standards you like—power plant, engineering design, construction—Adams Motor Graders are unsurpassed in the three fundamental respects which, more than any others, determine efficient, profitable operation . . . *abundant power, long-life dependability, operating economy.*

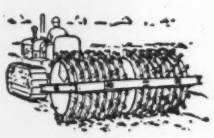
Take the husky International Diesel engines used in Adams Graders—they're *long* on power and dependability, *low* on fuel consumption! . . . Most heavy-duty Adams Graders—even on the toughest jobs—operate on two gallons or less of low-priced Diesel fuel per hour.

Structurally, Adams Motor Graders have the rugged strength and rigidity to withstand hard usage. Add to this Adams' in-built adjustments for taking up wear at all critical control points, and you have a combination of dependability and economy that guarantees long years of efficient, low-cost operation.

See your nearby Adams dealer for full details and the other advantages of Adams machines.

ASK YOUR DEALER ABOUT THESE MACHINES





J. D. ADAMS MANUFACTURING CO.
INDIANAPOLIS, INDIANA

Adams

ROAD-BUILDING AND EARTH-MOVING EQUIPMENT

Low in sensitivity to ordinary electric light, Photo-Arc can be printed in a normally lighted room — even in your drafting room.

Peerless Photo-Arc reproductions speed up reconversion planning

Now you can make any type of contact photo-reproduction with new ease, new speed, new standards of quality:

- Black line reproductions from pencil originals
- Sharp black and white prints on transparentized Vellum from blueprints or yellowed originals
- Reflexed negatives from opaque or two-sided originals
- Duplicates of letters and manuscripts

Moreover, every kind of Photo-Arc reproduction can be made on your blueprint machine.

Or, you can obtain a Photo-Arc printer at surprisingly low cost.

For further information write for Bulletin 9E

INDUSTRIAL PEERLESS PHOTO PROCESSES NEW YORK 6 N.Y.

valve at each bearing. An electric time clock controls frequency of operation and a signal device indicates any interruption.

This unit can also be furnished with rotary drive and hydraulic timing for individual machine lubrication.—*The Farval Corp., 3249 East 80th St., Cleveland, Ohio.*

Hook Latch

Eighty percent of full throat opening is possible with a new safety hook latch, and its proper operation is said to eliminate overloading and overcrowding. The latch assembly, when open,

straddles the neck of the hook. The load slips easily into the hook, but cannot be removed until the operator releases the latch. If the hook is overcrowded, the latch will not snap into place; if excess loading spreads the hook, the latch pops up as a warning signal.

Made of pressed steel in the smaller sizes and cast bronze in the larger, the latch, riveted to a cam at the neck of the hook, is actuated by a stainless steel wire spring.—*The Thomas Laughlin Co., Portland, Me.*

Ground Resistance Tester

A large range of low and high ground electrical resistance testing is provided by a new Model 255 Vibroground, it is stated. While it gives accurate readings for all ground conditions, this device is particularly adapted to extremely arid or wet regions. Its one-piece welded metal case is water-tight and portable.

This tester has four ranges, 0-3, 0-30, 0-300 and 0-3000 ohms; its self-contained power supply eliminates hand cranking. It is so designed as to exclude strays from high potential networks, DC ground currents or AC commercial frequencies. — *Associated Research, Inc., 231 South Green St., Chicago 7, Ill.*

Elections and Activities

C. L. Marley, member of the Ontonogon, Mich., County Road Commission, was elected president of the Upper Peninsula Road Builders' Association at a "streamlined" annual meeting held in Houghton. Mr. Marley, who served as vice-president during the past year, succeeds George L. Depew of Munising. William A. Gray of Ishpeming was elected vice-president and Robert K. Stephens of Kingsford was chosen secretary-treasurer.

The Texas Water Conservation Association will hold its yearly meeting at Austin on October 3 and 4. The program will include an inspection tour of four dams operated by the Lower Colorado River Authority and reports will be received from federal and state agencies of their plans for soil and water conservation in Texas.

The following officers have been elected by the Ft. Worth Chapter of the American Society of Civil Engineers: Uel Stephens, president; Henry Rockwood, vice-president and E. L. Ferguson, Secretary. Committees appointed were: Membership: S. Gardner Endress, J. A. Elliot, E. C. Woodward. Public Relations and Publicity: Joe J. Rady, W. O. Jones, P. M. Heren, H. H. Hester. Professional Welfare: C. M. Thelin, C. M. Davis, Ivan Jensen; and Program: J. W. Bradner, Jr., A. C. Blomgren, K. W. Damerow.

Edward de Luca, Jacksonville industrial engineer has been appointed chairman of the Florida Engineering Society's Postwar Planning Committee. Other members include S. S. Bouis, engineer at the Hookers Point Shipyard, Tampa; R. O. Couch, engineer, Melbourne, Fla.; H. K. Davison, civil engineer, Fort Myers; C. H. Overman, civil engineer, Pensacola, Fla.; R. Y. Patterson, vice president in charge of engineering, U. S. Sugar Corporation, Clewiston, Fla.; R. G. Ridgely, city manager, St. Petersburg, Fla.; W. O. Snyder III, assistant operations engineer, Africa Orient division, Pan-American Airways, Miami; J. Weil, dean of the College of Engineering and Industrial Experiment Station, University of Florida, Gainesville and M. N. Yancey, city manager, Tallahassee.

James C. Harding of Mount Kisco, N. Y., Westchester County Public Works Commissioner, has been elected chairman of the Westchester Water Works Conference. Mr. Harding succeeded Dan C. Nolan, Jr., Greenburgh town engineer. Richard M. McLaughlin, White Plains, sanitary inspector of the County Health Department, was reelected secretary-treasurer. New directors are Arthur Jewell, superintendent of the Mount Vernon Water Department; J. E. Flanders, New Rochelle Water Company superintendent, and Mr. Nolan.

Members of the executive committee of the Rockford, Ill., city-county planning commission has been appointed by Chairman Arthur L. Johnson as follows: Ernest Estwing, chairman, County Forester Al Hougan, and Arthur L. Johnson. Serving as ex-officio members of the committee will be Mayor C. Henry Bloom and Assistant Supervisor Herman G. Nelson, chairman of the county board of supervisors.

Committee chairman named are: Eric Anderson, roads and bridges; T. G. Lindquist, housing and building; A. R. Carter, plots, subdivisions, and zoning, Dr. N. O. Gunderson, sanitation and public health; W. E. McCoy, public utilities; Arnold Lundgren, flood control; Earl G. Elliot, schools, parks, and recreation.

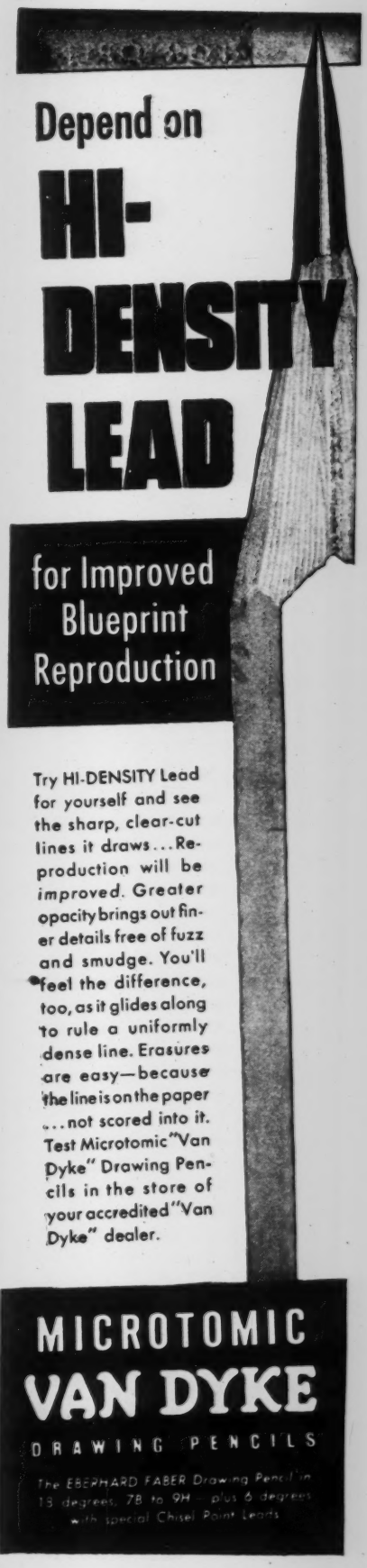
A drive to increase membership in the Sacramento group of professional engineering employees, formed last year by the Sacramento, Calif., Section of the American Society of Civil Engineers, is under way.

The group already has over 150 names on its roster, including many in high engineering positions, such as heads of state engineering departments.

The Sacramento collective bargaining unit was formed in accordance with a plan outlined by the board of directors of the A. S. C. E., who encouraged professional engineers to organize when it developed that non-professional groups were in several instances claiming the bargaining right and having their claims allowed.

Organization of Syracuse Post, American Military Engineers, has been started at Syracuse, N. Y., with the election of Harold M. Ross as executive secretary, who will act for the society in all matters until this month, when by-laws will be prepared and adopted and a complete slate of officers elected.

Officers of the Municipal Contractors Association, the Texas Society of Professional Engineers, and the League of Texas Municipalities, meeting at Fort Worth recently, voted to create a municipal construction council for the state. The council will have fifteen members.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SAVES MONEY FOR YOU

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2. Safer—the combination of Hex Bars and Fillet Welding produces safer grating—and, safety is a big *economy* factor.

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Get a bid from BATES on every job where you need GRATES

Reports and Pamphlets

(*Continued from page* 128)

HARTFORD METROPOLITAN AREA EXPRESSWAYS—Bureau of highway Planning Studies, Connecticut State Highway Department, Hartford, Conn.

CONTROL OF QUALITY OF READY-MIXED CONCRETE—National Ready Mixed Concrete Assn., Munsey Bldg., Washington, D. C.

SURPLUS PROPERTY—Quarterly progress report by the surplus property board to the Congress.

ANNUAL REPORT OF PROGRESS, 1944—County Planning Board, County of Bergen, Hackensack, N. J.

NINETEENTH ANNUAL REPORT OF THE SOUTH JERSEY PORT COMMISSION TO THE LEGISLATURE OF NEW JERSEY, Jan. 29, 1945.

FORTY-FIFTH ANNUAL REPORT OF THE WATER DEPARTMENT, DUBUQUE, IOWA, April 1, 1944 to March 31, 1945.

TENTH BIENNIAL REPORT OF THE BOARD OF WATER SUPPLY, City and County of Honolulu, 1943-1944.

PITTSBURGH, PA.—Annual Report of the City Planning Commission, 1944. Department of City Planning.

FINAL LEGISLATIVE SYNOPSIS AND DIGEST OF THE SIXTY-FOURTH GENERAL ASSEMBLY, STATE OF ILLINOIS—Action on all Bills and Resolutions Received to June 30, 1945.

STEELTYD GROUTED REINFORCED BRICK MASONRY—Distributed by the Davidson Brick Co., 4701 Floral Dr., Los Angeles 22, Calif.

IMPORTANT ENGINEERING DATA and Construction Details as required by the 1943 Building Codes for Steeltyd Reinforced Brick Masonry including Los Angeles City, Los Angeles County and the Uniform Building Code. Distributed by the Davidson-Brick Company, 4701 Floral Dr., Los Angeles 22, Calif.

PROCEEDINGS OF THE AMERICAN RAILWAY ENGINEERING ASSOCIATION, Vol. 46, 1945—American Railway Engineering Assn., 59 East Van Buren St., Chicago 5, Ill.

PROCEEDINGS OF THE FIFTH ANNUAL WATER CONFERENCE OF THE ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA—Copies may be obtained by writing to the society office, Hotel William Penn, Pittsburgh. $3.50.

COLLECTIVE BARGAINING—By John W. Scoville. Newspaper Statistical Service, Lafayette Bldg., Detroit 26, Mich.

LOAD DISTRIBUTION OVER CONTINUOUS DECK TYPE BRIDGE FLOOR SYSTEMS—By W. S. Hindman and L. E. Vandegrift. Ohio State University Studies, Engineering Experiment Station, Columbus, Ohio. Bulletin No. 122. 25 c.

THE INSTITUTE OF SEWAGE PURIFICATION JOURNAL AND PROCEEDINGS, 1943-34, Cardinal's Walk, Hampton-on Thames, Middlesex, England.

PRICE LIST OF AMERICAN STANDARDS—American Standards Assn., 70 East 45th St., New York 17.

THE STATE COORDINATE SYSTEMS (A Manual for Surveyors)—By Hugh C. Mitchell and Lansing G. Simmons. Special Publication No. 235. For sale by the Superintendent of Documents, Washington 25, D. C. 25 c.

Miscellaneous Notes on Booklets and Reprints

A NEW COMPILATION of "Industrial Research Laboratories in the United States" is being made by the National Research Council, 2101 Constitution Ave., Washington, 25, D. C. Research laboratories that have not received a questionnaire are requested to apply to the library at the council headquarters.

REPRINTS of Waldo G. Bowman's articles in this journal on American Military Engineering in Europe have been made. Copies can be obtained by addressing the Editor, *Engineering News-Record*, 330 W. 42nd St., New York 18, price $1.

COMMENT ADVERSE to the proposed ship canal across New Jeersey are found in the report to the governor of New Jersey by the delegation sent to view the model studies at Vicksburg, Miss., (*ENR* June 28, vol. p. 912). The delegation raises a few questions about the tests, finds no justification for the canal, and characterizes the Army Engineers estimate of its cost as one of their historic under-estimates of large canal projects. Copies may be obtained from Russell E. Watson, 76 Adelaide Ave., New Brunswick, N. J.

"THE USE OF PUBLIC WORKS to Sustain Construction Activity," a 12-page pamphlet prepared by the Construction and Civic Development Department of the Chamber of Commerce of the United States, Washington, D. C., discusses the major potentialities and pitfalls of this proposal. It claims that construction cannot exercise an appreciable effect on our national economy but can make an effective contribution toward stability through measures designed to sustain its own volume so far as that is practicable.

TWO ILLUSTRATED PAMPHLETS have been issued by the Dominion Bridge Company, Ltd., Montreal, Canada: "Of Tasks Accomplished" provides a pictorial review of the company's war activities and "Builders in Steel" indicates its peacetime work.

When you buy a piece of equipment
When you order a machine rebuilt—
When you buy a needed part—
from a member of the

ASSOCIATED EQUIPMENT DISTRIBUTORS

YOU KNOW you are dealing with a substantial, well organized and reliable Company—a machinery distributor who owns property, machines, a stock of parts and has a complete distribution organization.

His financial standing has been thoroughly checked by the manufacturers whose products he handles.

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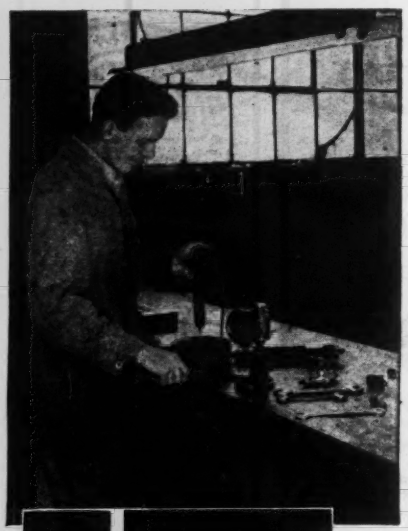

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Keeps Diesel Engines Running Efficiently

To keep diesel engines operating at peak efficiency, this portable, precision-built Adeco Nozzle Tester is indispensable.

Light in weight yet built for heavy-duty service, it enables any mechanic to make quick accurate tests on injector opening pressure, spray pattern, etc., and detect stuck needle valves and leakage around valve seats. Tests both large and small injectors, on bench or engine, at pressures up to 10,000 p. s. i. Prevents costly delays and possible damage to engine.

Ideal for testing hydraulic devices.

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Write for bulletin on this practical, low-cost unit.

TESTS FUEL INJECTORS AND HYDRAULIC DEVICES at Pressures up to 10,000 p.s.i.

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AIRCRAFT & DIESEL EQUIPMENT CORP.

DEPT. 14: 4411 N. RAVENSWOOD AVE.
CHICAGO 40, ILLINOIS

Manufacturers' Activities

DON POOR has been appointed advertising manager of Ceco Steel Products Corp., at the manufacturing division in Chicago, Ill. For five years prior to his new appointment, Mr. Poor, was assistant advertising and sales promotion manager of Lyon Metal Products, Inc., of Aurora and Chicago Heights, Ill. Previously, he was manager of the Stewart Howe Alumni Service in Evanston, Illinois, and Bloomington, Ind. He has a long record of civic activity, including the publicity directorships of the Aurora War Fund and community wastepaper and manpower drives.

Part of Mr. Poor's new assignment will be to control an institutional campaign embracing wide product diversification, including: Reinforcing steel fabricated at Ceco's plants in Omaha, Jersey City, Birmingham, Houston, Los Angeles and San Francisco; metal windows, joists, lath, roof deck, doors, screens and weatherstrip manufactured in the Chicago plants; and double drain roofing and corrugated siding rolled at Ceco's steel and wire division plant in Peoria.

COL. W. F. ROCKWELL, president of Pittsburgh Equitable Meter Co., Pittsburgh, Pa., has announced the formation of the Pittsburgh International Corp., with offices at 7701 Empire State Building, New York City. This firm will handle the export sale and distribution of products manufactured by Pittsburgh Equitable Meter Co.-Merco Nordstrom Valve Co., and subsidiaries.

The Pittsburgh International Corp. will be under the direction of A. L. DiGiulian, vice-president. Mr. DiGiulian has had extensive experience in foreign markets. He was educated in Europe, completing studies in Italy, Spain and Portugal. He was graduated from Georgetown University, School of Foreign Service, in 1927. Mr. DiGiulian, who is an accomplished linguist, has spent many years in U. S. Government service. His immediately prior connection was chief, Foreign Communications Section, Office of Exports, Foreign Economic Administration, Washington, D. C.

Mr. DiGiulian will be assisted in the operation of the export firm by George E. Doty, who, after attending Carnegie Institute of Technology, joined the Pittsburgh Equitable Meter in 1926. His experience embraces all phases of manufacture and sale of the company's products.

LIMA LOCOMOTIVE WORKS, INC. shovel and crane division, Lima, Ohio, and the Michigan Power Shovel Co., Benton Harbor, Mich. jointly announce the appointment of Hugh H. Buchanan as director of foreign operations for both concerns. Mr. Buchanan began his sales career twenty-two years ago. Since that time he has been with many leading manufacturers of earthmoving, excavation, material and steel erection equipment. Until recently, Mr. Buchanan was vice president and general sales manager of the LaPlante-Choate Manufacturing Co., Cedar Rapids, Iowa. He takes to his new position an understanding of foreign sales and development gained from years of contacts with users, distributors and dealers over the world.

The two companies now provide for world markets a complete line of shovels, cranes and draglines both crawler and truck mounted, in sizes ranging from ⅜ to 5 yards.

WALTER H. ROBERTSON has joined The Union Metal Manufacturing Co. as manager of piling sales and engineering. Prior to joining Union Metal, he was associated with Massey Concrete Products Co. as vice-president in charge of sales and engineering developments. He is a graduate of Massachusetts Institute of Technology and Harvard University. His headquarters will be at the Company's main plant in Canton, Ohio.

W. H. Robertson

Cove W. Sullivan, formerly manager of piling sales and engineering, is now manager of the New York district, handling the sale of all of the company's regular products.

R. A. Weinland has been named Lake States district manager.

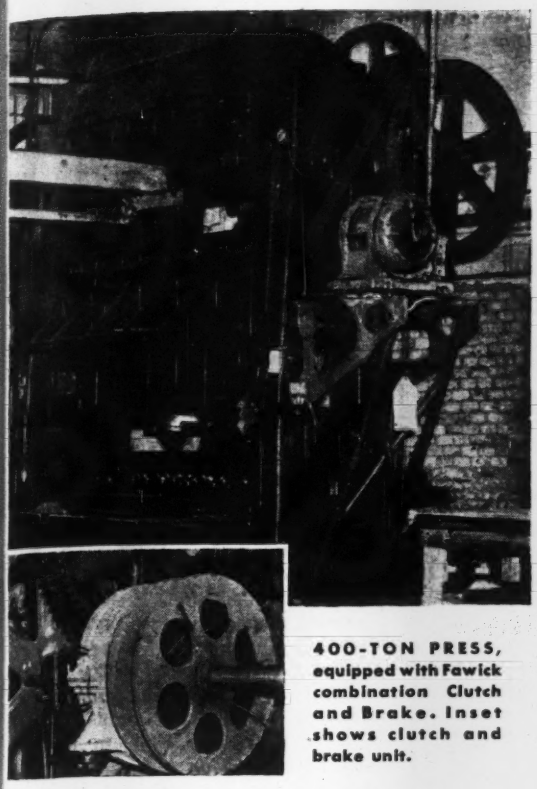
Robert M. Frost, before joining

FAWICK CLUTCHES
IN HEAVY-DUTY DRIVES

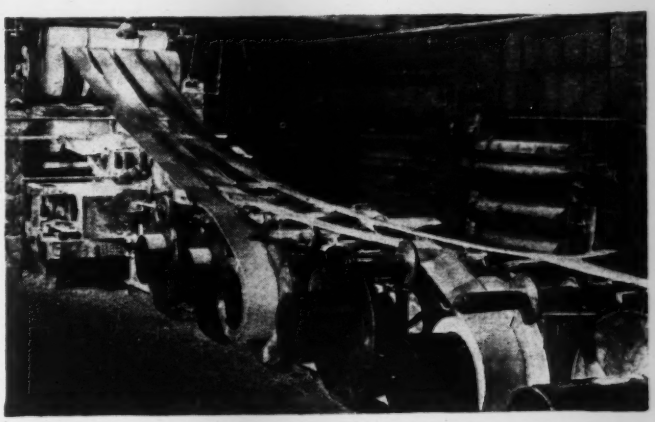
Machines that make quick starts and stops—under stress and shock—are proving the value of the Fawick Clutch.

This new clutch transmits power and absorbs torque through a cushion of rubber and air. It has no springs, arms or toggles, requires no lubrication or adjustments. Maintenance costs are unusually low, and power is controlled within close limits.

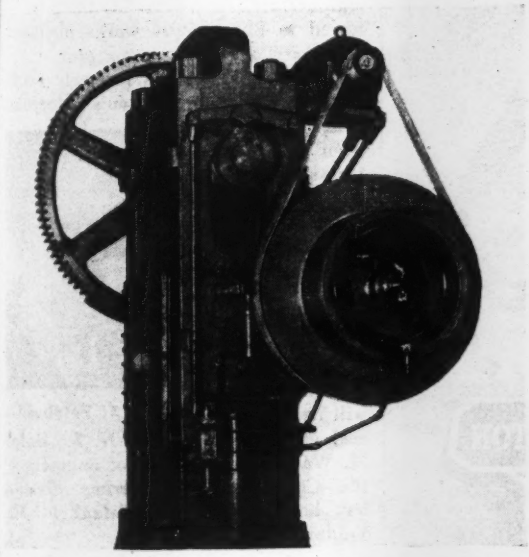
If you want this new clutch efficiency and economy, let us help you *engineer* Fawick Clutches for *your* machines. Book on request.



400-TON PRESS, equipped with Fawick combination Clutch and Brake. Inset shows clutch and brake unit.



STEEL ROLLING MILL equipment finds Fawick Clutches effective and economical, and suited to rigid product control.

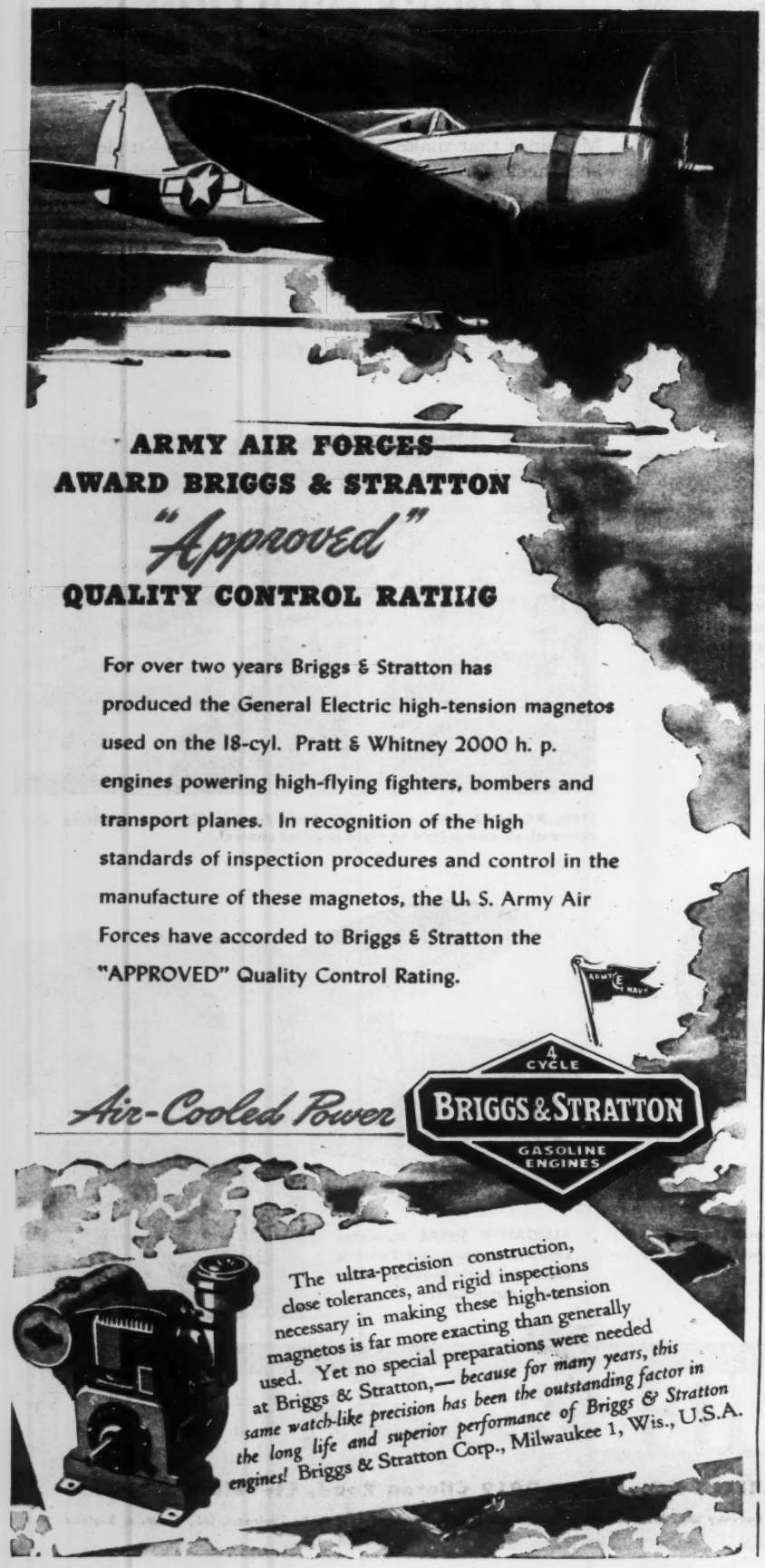


POWER PRESS, Fawick-equipped, has smooth starts and stops. "Inching" provided for without special equipment. Maintenance costs low.

ALLIGATOR SHEAR operates smoothly through Fawick Clutches and Brakes. Inset shows clutch unit.

FAWICK *Airflex* CLUTCH

FAWICK AIRFLEX CO., INC. • 9919 Clinton Road, Cleveland 11, Ohio


ARMY AIR FORCES
AWARD BRIGGS & STRATTON
"Approved"
QUALITY CONTROL RATING
For over two years Briggs & Stratton has produced the General Electric high-tension magnetos used on the 18-cyl. Pratt & Whitney 2000 h. p. engines powering high-flying fighters, bombers and transport planes. In recognition of the high standards of inspection procedures and control in the manufacture of these magnetos, the U. S. Army Air Forces have accorded to Briggs & Stratton the "APPROVED" Quality Control Rating.
ARMY E NAVY
Air-Cooled Power
4 CYCLE
BRIGGS & STRATTON
GASOLINE ENGINES
The ultra-precision construction, close tolerances, and rigid inspections necessary in making these high-tension magnetos is far more exacting than generally used. Yet no special preparations were needed at Briggs & Stratton,— because for many years, this same watch-like precision has been the outstanding factor in the long life and superior performance of Briggs & Stratton engines! Briggs & Stratton Corp., Milwaukee 1, Wis., U.S.A.

Union Metal was head of contract unit for the U. S. Maritime Commission. At present he is assisting on expediting and priority matters. Joseph A. Coblentz, formerly with McLean Contracting Co., Baltimore, Md., has been appointed sales engineer with headquarters in the Baltimore office.

HOBART C. RAMSEY, executive vice-president of Worthington Pump and Machinery Corp., has, in addition, been named president of the Ransome Machinery Co., subsidiary of Worthington in Dunellen, N. J., where concrete mixers and road pavers are made.

H. C. Ramsey

Named vice-president and general manager of the Dunellen plant is J. G. Ten Eyck, who has just completed five years active service with the U. S. Navy and who was formerly president of the industrial engineering firm of Ten Eyck, Inc. Kenneth W. Horsman, formerly superintendent of welding and steel fabrication at the Worthington Harrison Works has been transferred to Ransome as works manager.

HARRY A. FELDBUSH, formerly works manager of Worthington's Holyoke, Mass., plant, has been named vice-president in charge of engineering for the entire corporation. His duties cover engineering activities of all works and domestic subsidiary companies. His headquarters will be at the general offices in Harrison, N. J. Ralph M. Watson, formerly chief engineer of the Centrifugal engineering division has been appointed assistant to Mr. Feldbush.

H. A. Feldbush

SALE of the Malvern Clay Co., Malvern, Ohio, has been announced. Purchasers are R. C. Harsh, Minerva; and H. R. Cummings and W. J. Schilling of Malvern. The plant which produces about 8000 tons of structural steel a month, previously was owned by H. C. Ross, of Malvern and H. C. Downer of Magnolia.

The new owners purchased the total stock of the firm and have begun operations immediately. Officers include Mr. Harsh, president; Mr. Schilling, vice president; Mr. Cummings, treasurer and T. B. Hart, of Canton, secretary.

WE'VE GOT TO DO MORE THAN TALK ...AND QUICK!

Almost everybody today agrees that an adequate highway program is absolutely essential to a sound post-war economy. In fact, Congress has already voiced its approval by providing three billion dollars of federal funds.

Yet despite all the talk, the job of turning plans into blueprints is still far behind schedule!

Your state, your county has a tremendous responsibility in this important task. For unless adequate construction plans are completed and readied for bids immediately, it will be impossible to provide enough jobs to support the millions of returning service men and workers being released from war plants.

So unless we want "another WPA," it's up to all of us—engineers, public officials, contractors, distributors and manufacturers—to exert every possible effort to speed the completion of local plans, and to support competitive bidding as the one best way to build the kind of roads America needs at lowest possible cost to the Jaxpayer. LaPlant-Choate Manufacturing Co., Inc., Cedar Rapids, Iowa; San Leandro, California.

LACK OF PLANS JEOPARDIZING HIGHWAY PROGRAM

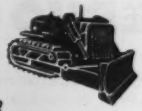
by Charles M. Upham—Engineer-Director
American Road Builders' Association

"With the need great and with funds available, we might well imagine all state and local highway departments busy as beavers turning out blueprints, writing specifications and doing all those engineering tasks which must be done before contracts can be let and the actual work started. Unhappily this is not the case. Only eight states have sufficient plans ready to make an adequate start; and this lethargy and delay may jeopardize the entire post-war program. It is a matter that concerns every reader of this publication for the condition of the nation's highways affects all of us, no matter where we live or what we do. The answer is to appeal to those charged with preparing plans to get busy immediately."

FOR REAL ECONOMY IN EARTHMOVING BETTER SEE THE NEW LPC'S

High-Speed Scrapers

Tractor-Drawn Scrapers



Hydraulic and Cable Dozers

Cable Operated Rippers

LAPLANT CHOATE
EARTHMOVING AND LAND CLEARING EQUIPMENT

Manufacturers' Publications

Data on Concrete Floors—Available are: A 24-page booklet on "Concrete Floor Finishes" and a complete treatise on floors and methods of floor topping; also U. S. Navy and Army specifications. —*Washington Mills Abrasive Co., 18 East 41st St., New York 17, N. Y.*

Welding Electrodes and Rods—A 33-page booklet helps make it easier for buyers to select the proper electrode or gas welding rod for their particular work. An unusual index based on the type and class of material to be welded makes it easier to select the electrode or gas welding rod best for welding a particular type of steel. There is a digest of useful data on physical properties, analyses of the weld metal deposit, operating characteristics, recommended current ranges and other necessary information.—*American Chain & Cable Co., Inc., Monessen, Pa.*

D. C. Resistance Measurements—This publication not only presents d-c resistance bridges, but the standards, galvanometers, accessories, etc., usually chosen for use with them. Instruments for a wide variety of applications are listed, including models for the most precise measurements, as well as those designed especially for routine testing, student instruction and many others. Each instrument is so completely described that scientists, teachers, technicians and test engineers can easily choose the items best suited for their specific use. *Leeds & Northrup Co., 4934 Stenton Avenue, Philadelphia 44, Pa.*

Industrial Safety Equipment—A 22-page separable-leaf catalog describes products said to be engineered to eliminate accident hazards. They include flashlights, portable inspection lights, explosion proof lamps, emergency flood lights, clamps, sockets, plugs, etc.—*Stewart R. Browne Mfg. Co., Inc., 258 Broadway, New York 7, N. Y.*

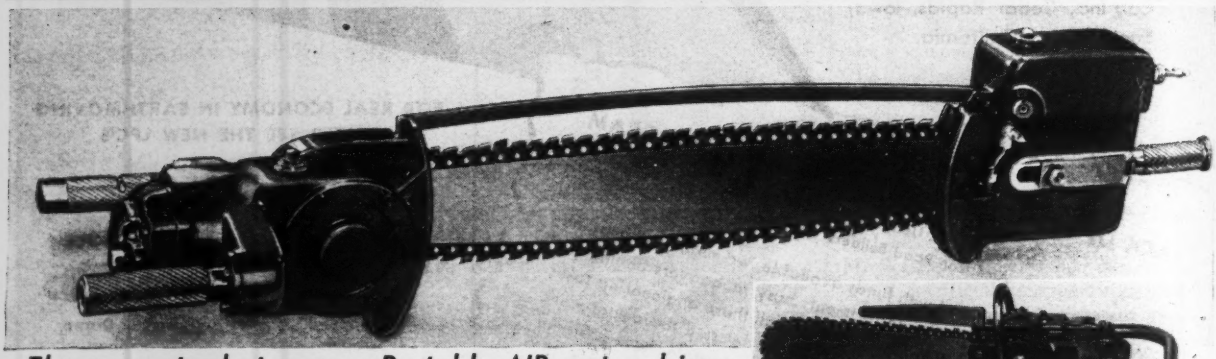
Ball Bearing Application—With 78 drawings and charts and a clear description, this book covers the fundamentals of bearing mounting applicable to all types, preloading methods, their effect on housing fits, the effect of press fits on preloading, the effect of preloading on bearing life; bearing creep, the use of duplex, shield and sealed bearings, etc. A companion book entitled, "Details of Design," issued last year and covering the details of shaft and housing design for ball bearings is also available.—*New Departure, Division General Motors Corp., Bristol, Conn.*

Deepwell Pumps—A bulletin illustrates and describes the latest developments in this field. Cut-away sketches are employed to show three deepwell pump types having more than 100 impeller designs, each with different hydraulic characteristics. — *The Byron Jackson Co., Terminal Annex, Los Angeles 54, Calif.*

Suction Hose—Construction of each of six grades of suction hose for excavating and general utility service is described in a new catalog. Featured is a spiral lock hose, including a patented process which locks the fabric around the spiral wire insertion, holding the wire firmly in position.—*The B. F. Goodrich Co., Akron, Ohio.*

Coal and Ashes Handling—A 60-page booklet tells all about coal and ashes handling machinery for power plants and boiler houses.—*The Jeffrey Mfg. Co., Columbus 16, Ohio.*

Immediate delivery—WITHOUT priority!



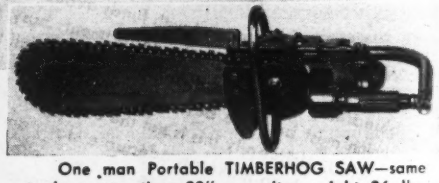
The same sturdy two-man Portable AIR motor driven

TIMBERHOG SAW

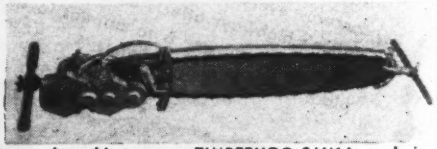
used by our Armed Forces is now ready for civilian use!

Powered by a 3½ HP air motor, operating at 90 to 105 lbs. pressure, this endless chain saw (see above) is recommended for general construction, timber, railroad, mine, shipyard and plant maintenance work. Available in 24" capacity — weight 50 lbs.

"Original and Largest manufacturers of portable timber saws—since 1927"



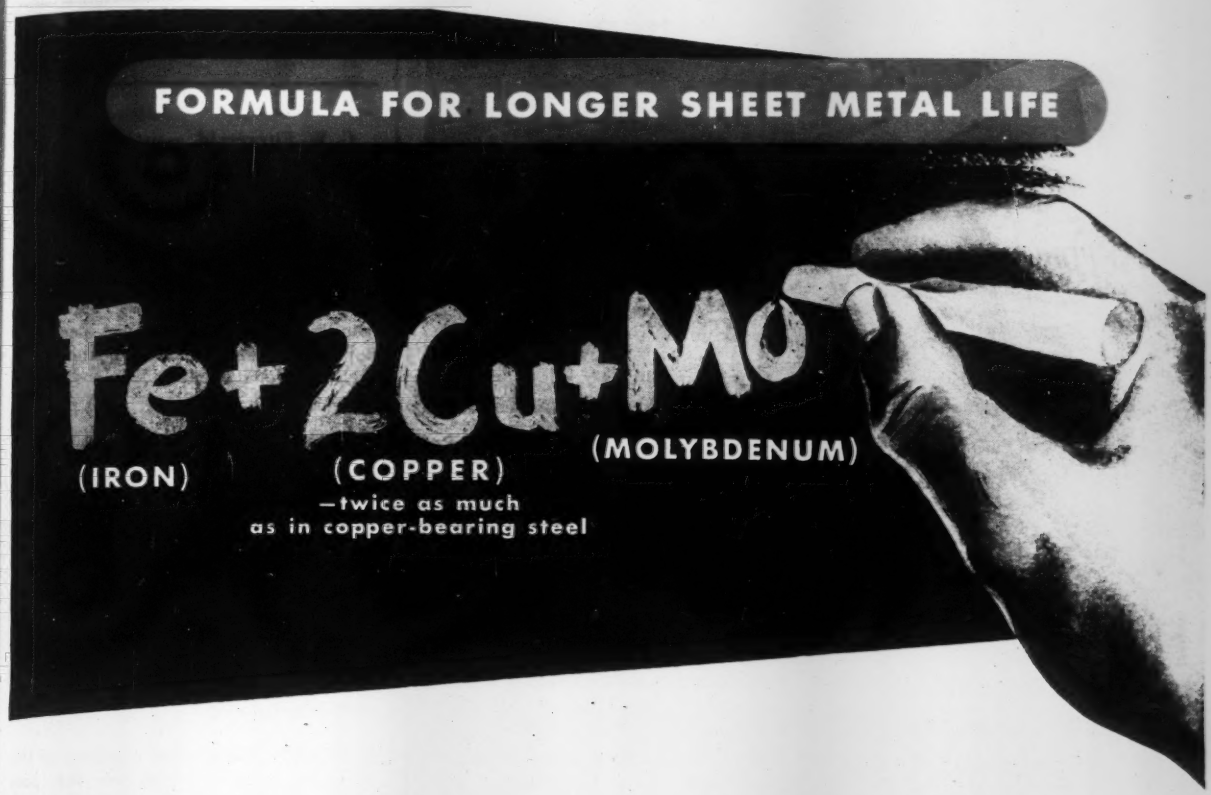
One man Portable TIMBERHOG SAW—same sturdy construction—20" capacity, weight 36 lbs.



For heavy duty this two-man TIMBERHOG SAW is made in 24" and 36" capacity. Powered by 4.1 HP air motor; wt. 36" capacity—85 lbs. Immediate delivery. Priority required.

TIMBERHOG
REED-PRENTICE CORP.
WORCESTER SAWS MASS., U.S.A.

★ ★ ★ ★



Toncan Iron contains Molybdenum

—a critical element in producing the Highest Rust-Resistance of All Ferrous Materials in its Price Class

That "Mo" in the formula for Toncan Iron could also stand for MORE —*more* rust-resistance than any other ferrous material in its price class. And a lot of that proved rust-fighting quality is due to the element Molybdenum.

The molybdenum increases the effectiveness of the rust-resisting copper content of Toncan Iron, which contains twice as much copper as copper-bearing steel. Molybdenum also helps refine the grain structure of the metal. And it aids in making Toncan Iron's rust-resistance impervious to all fabricating processes.

In Toncan Iron, Copper *and* Molybdenum are alloyed in correct proportion with open-hearth iron of high purity. This refined iron is low in chemical impurities and high in uniform grain structure—two factors that improve rust-resistance. And this basic highly-pure iron is specially processed for ductility to make Toncan Iron one of the easiest of all materials to fabricate.

There's a lot more to Toncan Iron that you should know to help your clients. It's all contained in Booklet No. 406, "A Few Facts about Toncan Iron for Architects and Engineers."

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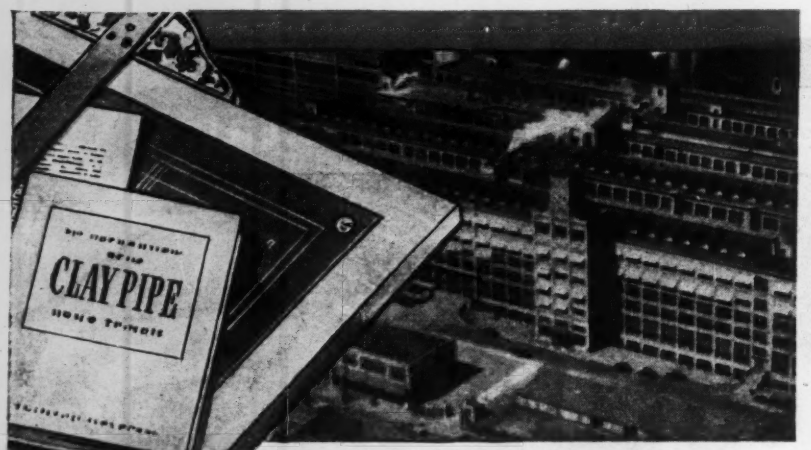

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AMERICA'S leading engineers don't gamble in the selection of pipe for industrial waste disposal lines . . . realizing that if the system fails, production can be held up for days. They select a pipe that will stand up indefinitely regardless of the kind of waste it must carry — Clay Pipe — the only pipe that inherently combats the corrosive action of gases, acids, alkalies.

That's because Clay, Nature's most enduring material, is processed by today's modern methods and scientific equipment into a pipe possessing maximum strength, density and uniformity. Vitrification under exact high temperatures provides the tough, hard texture which fights off corrosion and provides faster, smoother flow.

Clay Pipe's proved dependability for *enduring* sewerage and drainage systems is the big reason why engineers for the largest industrial plants — along with engineers responsible for 89% of municipal sewer mileage — prefer and specify Clay Pipe. They *know* that here's one pipe that's safe for *any* kind of waste.

Write for information. It will be cheerfully supplied direct or through one of the regional association offices.

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Westinghouse Elec. & Mfg. Co.
Union Carbide & Carbon Corp.
E. I. du Pont de Nemours Co.
Dow Chemical Co.

C-1244-21

Men and Jobs

C. W. Fitzgerald, assistant area engineer for the E. I. duPont Co., of St. Paul, Minn., has been named to serve as Madison County, Tenn., first highway engineer under provisions of a recent act of the general assembly.

Zearl Ahelfeld, former state and county highway worker has been appointed superintendent of the state highway department office in Bucyrus County, Ohio.

Walter Hopkins, of Brawley, Calif., has been named city engineer and supervisor of departments for the town of Hanford, Calif.

W. C. Olsen, of Raleigh, N. C., has been named consulting engineer in charge of planning and directing construction of a proposed administration and terminal building and other improvements at the Raleigh-Durham airport.

Floyd E. Bates, chief engineer of the Missouri Pacific Lines for the past seven years, has been promoted to executive assistant. **Roy E. Hart,** formerly assistant chief engineer, has taken Mr. Bates' place.

Paul Harley recently assumed charge of a new office of the Federal Bureau of Reclamation at Grand Island, Neb. The office will carry out direct supervision of the bureau's investigations of plans for utilizing waters of the Platte River for irrigation, power and related uses.

Roy L. Williamson, city commissioner of public works, at Raleigh, N. C., for he past five years, has been appointed city manager of Burlington.

Maj. J. H. Ellett is now commanding officer of the Plum Brook ordnance works at Sandusky, Ohio. **Capt. J. H. Beauchamp,** formerly resident engineer at Plum Brook, has been transferred to Pittsburgh.

Leigh R. Sanford, of New Orleans, La., widely known naval architect and marine engineer, has been named regional director of construction for the eastern region of the U. S. Maritime Commission, with offices at Philadelphia, Pa.

Capt. Kerwin L. Mich, Minneapolis, chief chemist for the Twin Cities sewage disposal system, has been ap-

A Tribute

to all those who helped in the greatest scientific achievement of all time... the

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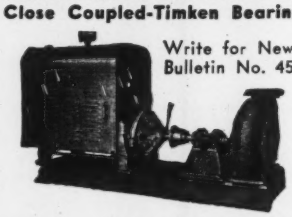

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pointed chief engineer and superintendent, to take effect this month.

Arthur C. Nauman, former area engineer for the U. S. Engineers, Spokane, Wash., has been promoted to colonel in the Army Service Forces on Luzon.

Fraser S. Keith, former manager department of development, the Shawinigan Water & Power Co., Montreal, Canada, has been elected as graduate representative on the board of governors of McGill University.

Lt. Col. E. G. Cooper, native of Milton, Fla., and an engineer in the Florida State Road Department for years before entering the armed forces, has become deputy base commander at Hendricks Field, Fla.

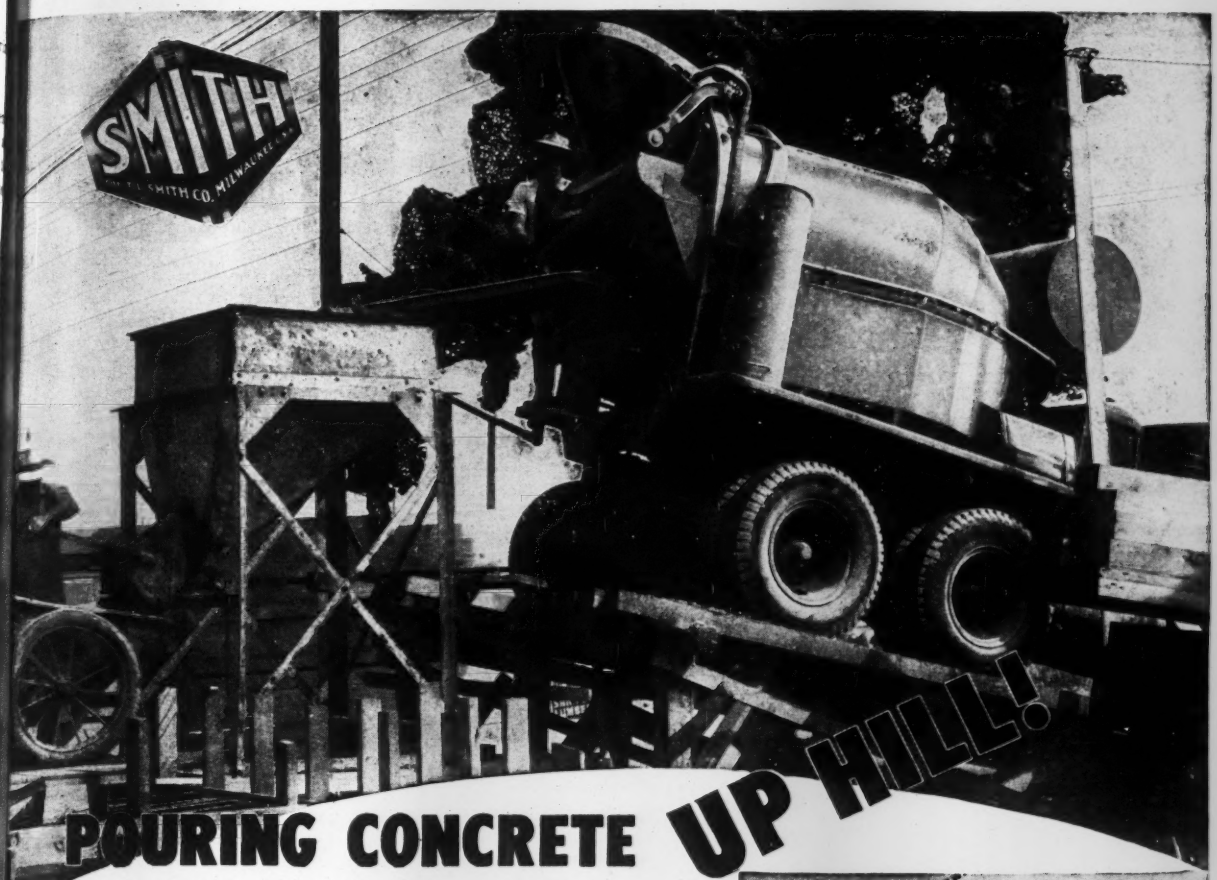
C. M. Allen and **H. L. Estridge,** of Charlotte, N. C., and **V. J. Allen,** of Mount Holly, N. C., have formed a contracting, engineering and construction firm at Charlotte.

Wilbur Nielsen, president of the Wilbur Nielsen Construction Co., of Onawa, Iowa, has received a discharge from the Marine Corps, and returned to his construction business.

J. M. Jarrett, of Raleigh, N. C., chief engineer for the state board of health, has been elected chairman of the Stream Sanitation and Conservation Committee. **W. H. Riley,** engineer for the State Board of Conservation and Development, was elected secretary of the commission.

Maj. R. K. Horton, Sanitary Corps, U. S. Army, assigned to the Division of Health and Sanitation of the Institute of Inter-American Affairs, is joining the field party of that organization in El Salvador as sanitary engineer under the direction of Lt. Col. H. W. Van Hovenberg. Major Horton will be engaged in the experimental work of treating coffee mill waste to prevent the pollution of drinking and irrigation water supplies. Major Horton was formerly with the institute working on the Chimbote project in Peru which included permanent malaria control and the installation of water supply and sewerage systems.

Louis F. Birkel, formerly assistant sanitary engineer with the Kentucky State Health Department, has accepted a position as assistant sanitary engineer in the Division of Health and Sanitation of the Institute of Inter-American Affairs. Mr. Birkel is being assigned to the institute's field party in San Jose, Costa Rica, to assist in the develop-



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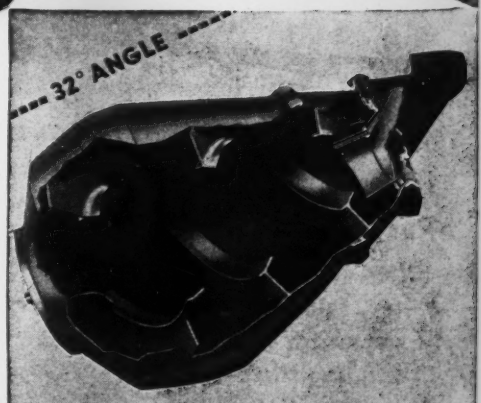

The illustration above shows a No. 4 Smith-Mobile, one of a fleet operated by Western Concrete and Equipment Company and used in the construction of a Southern California war plant. This Smith-Mobile is discharging concrete into a high floor hopper. The ramp is a 14° grade and the axis of the mixer drum is 18° from horizontal — yet the speed of discharge is NOT seriously affected by this steep incline.

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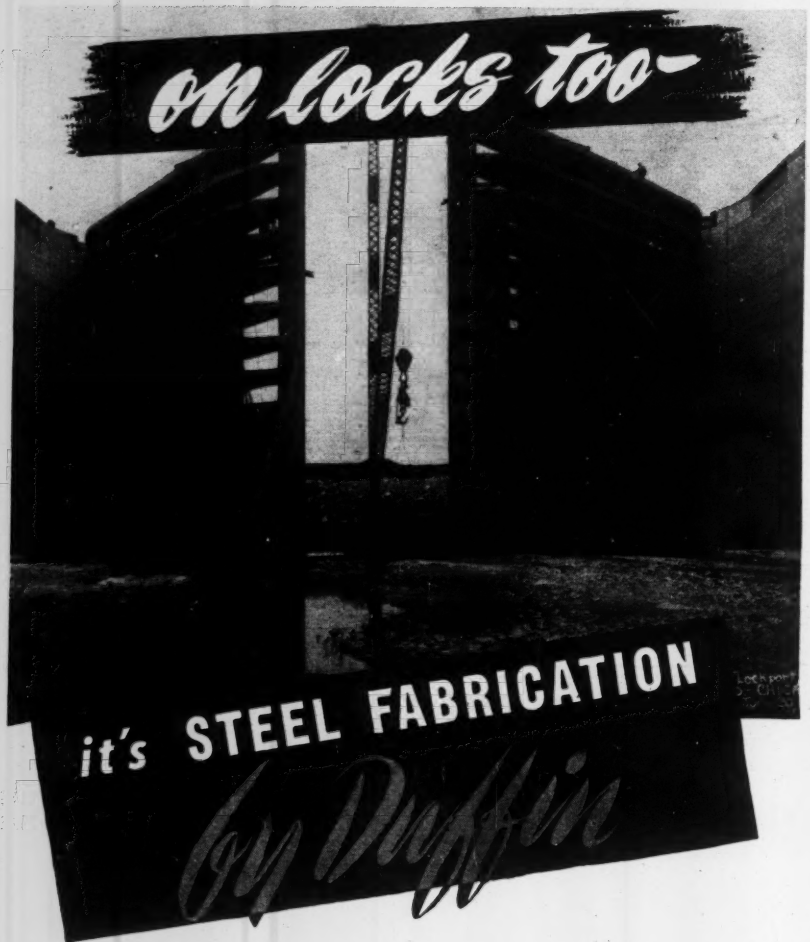

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ment of public water supplies and sewerage systems in that country.

Capt. C. J. Ordon, Sanitary Corps, U. S. Army, is being reassigned by the Division of Health and Sanitation of the Institute of Inter-American Affairs to its field party in Ecuador and will make his temporary headquarters in Guayaquil. Captain Ordon will assist in the development of a general sanitation program in the Guayaquil area. He was formerly with the Institute on the Amazon River program in Brazil, being engaged in malaria control and general sanitation work on that project.

Grant M. Hinkamp, a 1913 graduate of the school of civil engineering at Purdue University and for the past 4 years with Stone & Webster, is now with the Allis-Chalmers Manufacturing Co. as engineer in the public works division of the industrial sales department.

Captain William H. Godson, Jr., a member of the civil engineer corps, U. S. Navy, has been promoted to commodore. A member of the corps since 1940 Commodore Godson has served as officer in charge of civil works construction at Newport News, Va.; Erie, Pa.; Groton, Conn.; Quincy, Mass.; and Camp Perry, Va. He also served as officer in charge of Construction Battalion 137, as officer in charge of Naval Construction Battalion Training Center, Camp Le Jeune, N. C., and public works officer at Camp Le Jeune and at the 12th Naval District with headquarters at San Francisco and most recently was in charge of Second Naval Construction Brigade. Commodore Godson received his education at Syracuse University.

George F. Axt has become associated with Gannett Fleming Corddry and Carpenter, Inc., engineers, as manager of the New York office of the firm. For three years Mr. Axt was assistant regional supervisor for the Home Owners' Loan Corporation in New York. Recently he has been architect consultant to the engineer on the New York Municipal Airport at Idlewild.

W. B. Smith, chief of the operations division of the New Orleans, La., engineer district, has retired after 38 years of government service. Most of his service was in connection with maintenance of the passes at the mouth of the Mississippi River, although in recent years he devoted much time to executive duties in the district office.

James W. Bradner, Jr., divisional engineer of the FWA at Fort Worth, Tex., is the new city manager of Waco. He succeeds **Col. W. C. Torrence,** retiring because of poor health.